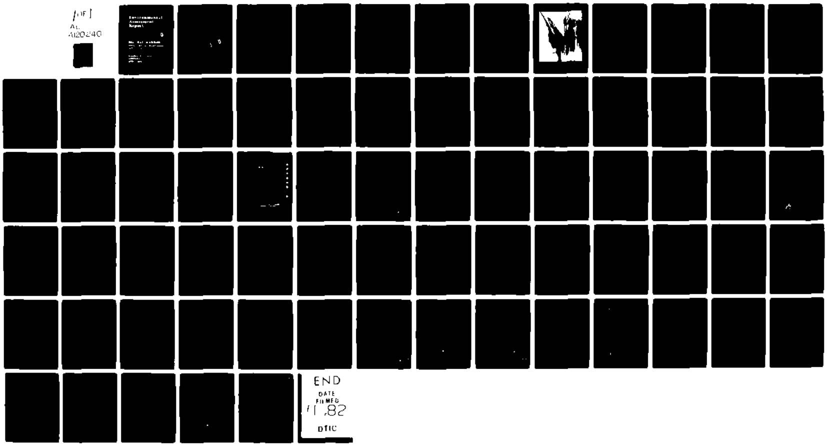
AD-A120 240 CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT F/G 13/2
BIG BAY HARBOR OPERATION AND MAINTENANCE ACTIVITIES, MARQUETTE --ETC(U)
APR 75

UNCLASSIFIED NL



AD A120240

DTIC FILE COPY

Environmental Assessment Report

BIG BAY HARBOR

OPERATION and MAINTENANCE ACTIVITIES

MARQUETTE COUNTY MICHIGAN

APRIL 1975

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) BIG BAY HARBOR, OPERATION AND MAINTENANCE ACTIVITIES, MARQUETTE COUNTY, MICHIGAN, Environmental Assessment report.	5. TYPE OF REPORT & PERIOD COVERED Environmental assessment
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Paul, 1135 U.S. Post Office and Custom House, St. Paul, MN 55101	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS	12. REPORT DATE April 1975
	13. NUMBER OF PAGES 61
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report) Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

DTIC ELECTE OCT 13 1982 S D H

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Environmental assessment
Big Bay, Michigan

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The report assesses the impact of harbor maintenance activities in Big Bay Harbor and harbor-related shoreline erosion. The adverse impacts are generally short-term in nature and are outweighed by the social benefits. Environmental effects include turbidity resulting from dredging and its side effects and the need for on-land or open lake disposal of sediments.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

ENVIRONMENTAL ASSESSMENT REPORT

Operation and Maintenance
Big Bay Harbor
Big Bay, Michigan
Lake Superior

DEPARTMENT OF THE ARMY
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101
April 1975

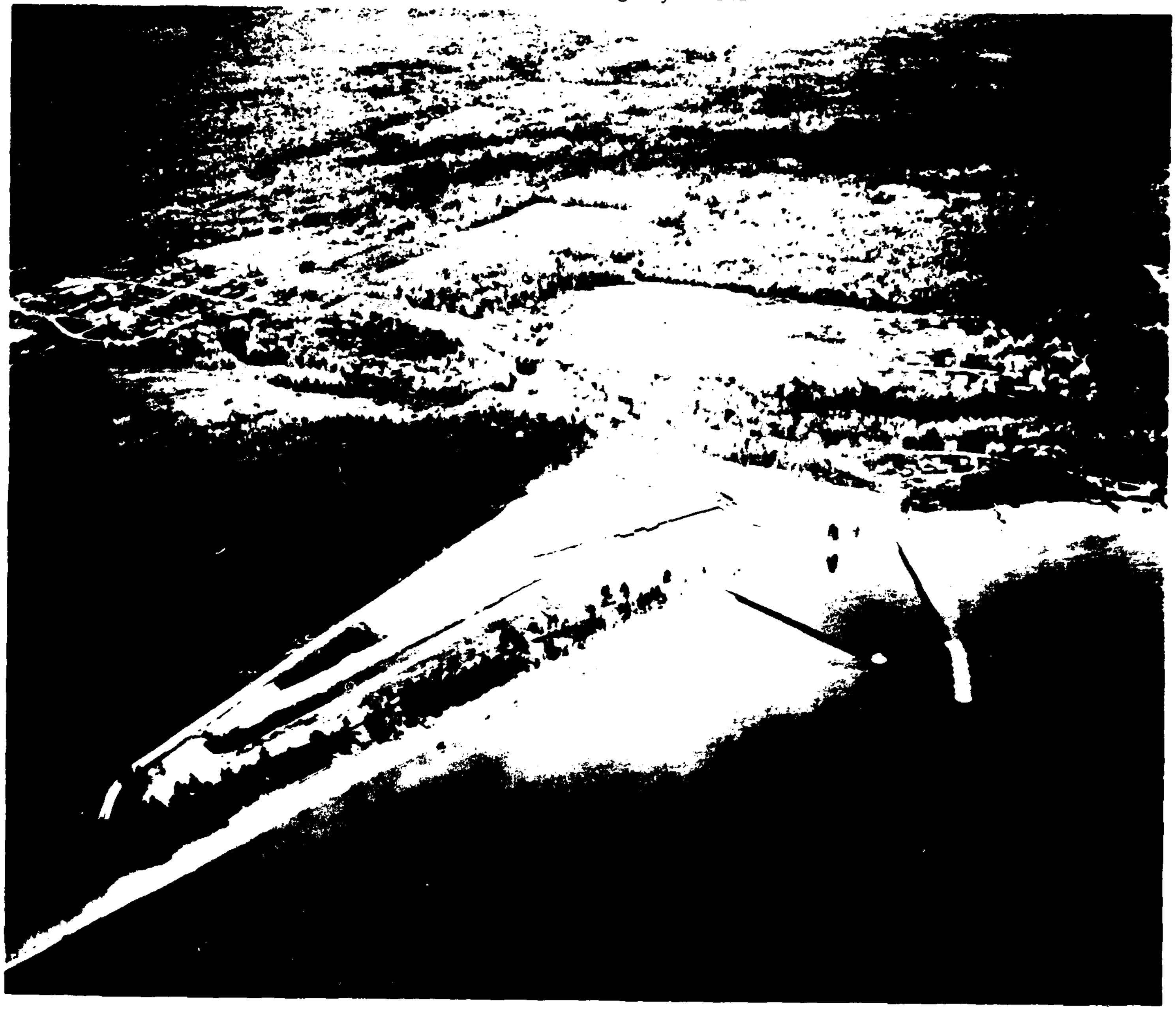
ENVIRONMENTAL ASSESSMENT REPORT
OPERATION AND MAINTENANCE
BIG BAY HARBOR
BIG BAY, MICHIGAN
LAKE SUPERIOR

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

Aerial View of Big Bay Harbor



ENVIRONMENTAL ASSESSMENT REPORT
OPERATION AND MAINTENANCE
AND HARBOR RELATED SHORELINE EROSION
BIG BAY HARBOR
BIG BAY, MICHIGAN
LAKE SUPERIOR

INTRODUCTION

The purpose of this report is to assess the environmental impacts associated with the St. Paul District Corps of Engineers harbor maintenance activities in Big Bay Harbor and harbor-related shoreline erosion. This assessment has been drawn in part from an environmental report prepared by National Biocentric, Inc., under contract with the Corps of Engineers. National Biocentric's report is on file in the St. Paul District office.

1.000 PROJECT DESCRIPTION

1.100 Project Location. Big Bay Harbor is located in Marquette County, Michigan, on the south shore of Lake Superior in Michigan's Upper Peninsula at latitude 46° 49' N and longitude 87° 44' W. The harbor is located 33 miles northwest of Marquette and 38 miles east of the lower (portage) entry to the Keweenaw Waterway. (See exhibit 1, page A-1).

1.200 Project Purposes. Big Bay Harbor was developed as a harbor-of-refuge to accommodate recreational and commercial fishing craft.

1.300 Project Authorizations. The construction of Big Bay Harbor as a harbor-of-refuge was authorized through the River and Harbor Act of 1945, although construction did not begin until 1960. The existing harbor is the result of joint cooperation between Marquette County, the Michigan State Waterways Commission, and the Corps of Engineers. Harbor development involved the construction of two breakwaters, an entry channel and an inner harbor basin. The harbor is entirely man-made.

1.301 A shoreline processes study is presently being conducted under the authority of section 111 of the 1968 Rivers and Harbors Act for the purpose of determining whether the Corps structures are responsible for the erosion problem. The first phase of this study will be completed in June 1975.

1.400 Existing Project. The harbor entrance is defined by two breakwaters extending out from shore (exhibit 2). The east breakwater is oriented south-southwest to north-northeast and extends 471 feet into Big Bay. The west breakwater is slightly doglegged

to the right and oriented southwest to northeast along its 787 foot length. At the shore end the structures are approximately 430 feet apart, but at the east pierhead the distance between them decreases to 120 feet. Construction was completed by November 1961.

1.401 The inshore 547 feet of the west breakwater consists of a central steel sheet pile wall with stone protection at its base. The remaining 240 linear feet is constructed of steel sheet piling cells filled with sand and capped with 2 feet of grouted rock. There is a navigation light on the lakeward end of the breakwater.

1.402 The east breakwater, when first constructed, consisted of 439 feet of a central steel sheet pile wall with stone protection at its base and a double layer of cover stone. The breakwater was damaged by a storm in 1966 and repairs were completed in 1969. Approximately 250 lineal feet of damaged sheet pile at the shoreward end of the breakwater was replaced with rubble mound and the adjacent shore was rebuilt with pumped sand and riprap. At the lakeward end of the breakwater there is a 32-foot diameter single steel sheet pile cell which is constructed like the west breakwater cells and topped with a navigation light.

1.403 The entry channel and inner basin combine to form an "L" shaped harbor. The entry channel is approximately 800 feet long and is authorized for a 12-foot project depth. The channel flares lakeward of the east pierhead but for most of its length it is 80 feet in width. At the south end of the entry channel is a rectangular harbor basin 100 feet wide and 430 feet long at right angles to the entry channel with a depth of 10 feet.

1.404 Additional Corps structures include 250 feet of steel sheet pile revetment extending along the inner harbor shore adjacent to the west breakwater. A 180-foot, stone-filled steel sheet pile revetment has been built on the east of the entrance to the breakwaters. On the lakeshore by each breakwater there is stone protection (125 feet west and 200 feet east). During its brief history the harbor has been subject to beach erosion east of the east breakwater. The erosion has been continuous but was accentuated by the severe storm in November 1966 which partially destroyed the east breakwater. High lake levels have also aggravated the erosion problem.

1.500 Improvement By Others. Local interests and the Michigan State Waterway Commission have cooperated to expand the basin by widening it 50 feet on each side to a depth of 6 feet on the north and 8 feet on the south and lengthening it about 100 feet with an 8-foot depth. Thus, the overall dimensions of the harbor basin are 530 by 200 feet. A narrow 250-foot channel, dredged by private interests, extends eastward from the east end of the basin (see exhibit 2).

1.600 Future Structures. At the present time there are no Corps projects proposed or under construction in Big Bay Harbor.

1.700 Operation and Maintenance. The purpose of the Corps of Engineers structures in Big Bay Harbor is to maintain the harbor entry, provide navigational safeguards, and to provide a harbor-of-refuge. The principal operation and maintenance activities attendant to this end involve breakwater repair, dredging, and dredged material disposal. The present requirement for maintaining the harbor dates back to 1945 (see exhibit 3).

1.710 Breakwater Maintenance. The principal Corps structures in Big Bay Harbor are the two breakwaters. The crane barge MARKUS attended by the tug DULUTH and the tender FAIRCHILD are the usual complement of equipment used to repair the Big Bay Harbor breakwaters. The MARKUS can be used to transport repair equipment and supplies and can be equipped with a mechanical rock grapple for hoisting, moving, and placing 3 to 10 ton boulders at the repair site. Maintenance consists primarily of replacing rock torn from the Big Bay breakwater during Lake Superior storms. The Corps purchases rock from local sources for use in structure repair work.

1.720 Dredging. The initial construction of Big Bay Harbor channel and basin necessitated the removal of 101,000 cubic yards of material under Corps contract during the 1960-61 period. Approximately 174,000 cubic yards of sediment have subsequently been dredged in maintenance operations. The largest amount removed in a single maintenance dredging operation was 10,775 cubic yards in August, 1974; the smallest amount removed was 3,740 cubic yards in July, 1971 and September, 1970. Although the harbor channel and basin were authorized for a project depth of 12 feet, present control depths are 10 feet, and Corps plans are to maintain the current harbor depth. Dredging is necessary to remove sediments carried into the harbor by wave action and littoral currents.

1.721 Costs. The cost of past dredging in Big Bay Harbor was approximately $56,000. The anticipated dredging costs for the next 10 years are $180,000, with Fiscal Year 1976 costs anticipated at $35,000.

1.722 The material which is dredged from the harbor consists mainly of sand with small amounts of silt, clay, and varying organic matter. Organics are especially high in the inner harbor.

1.730 Dredge Material Disposal. The Environmental Protection Agency (EPA) has classified the inner harbor as polluted. The outer harbor is not judged to be polluted (see exhibits 2 and 4 for designation of polluted and non-polluted areas). The Corps of Engineers has estimated a total dredging of approximately 50,000 yards over the next 10-year period of which the largest portion would be taken from the mouth of the breakwaters (in the outer harbor). It is estimated that approximately 2,000 cubic yards would need to be dredged from the inner harbor.

1.731 During the dredging operation, dredged materials are placed by the clamshell dredge into bottom dump scows for removal from the dredge site to the disposal area. Dredged material has been disposed of as beach nourishment adjacent to the shore extending 500 feet east from the east breakwater. Dredged material used for beach nourishment is dumped close to the shoreline in waters averaging 8 feet in depth. A second designated disposal site is located in the lake due north from the pierhead of the east breakwater beginning at the 50-foot contour. The use of this site has been very limited due to requests for beach nourishment east of the harbor.

1.732 Confined Disposal. Initial investigations into alternative disposal methods for polluted sediments, under the guidance of an independent group of consultants in cooperation with the Environmental Protection Agency and the Corps of Engineers, were unable to determine specific adverse impacts of open water disposal of polluted sediments. Resulting recommendations, however, noted that confinement of polluted dredged material for a period of years, combined with elimination of the sources of channel and harbor pollution, would result in improved water quality in the Great Lakes.

1.733 Present plans are to dispose of the 2,000 cubic yards of polluted sediments from Big Bay Harbor on-land at a site where leaching of the sediments back into the harbor is not probable. The site covers approximately 2 acres just south of the harbor in an area which has been the site for previous deposition of dredge material (see exhibit 2). The area is predominantly sand, and most of the material has failed to reseed effectively with sparse bunches of beach grass, wild peas, and an occasional aspen being the only vegetation there. The county of Marquette is the local sponsor of the project and owns the proposed disposal site.

1.734 Due to the insignificant amount of material being dredged from the polluted area EPA has stated that open lake disposal of all sediments dredged from Big Bay Harbor is permissible, but that the proposed on-land disposal plan would be preferable (see exhibit 10, page A-41). The Corps plans, therefore, to perform the proposed on-land disposal. If, before the next dredging operation, the county indicates plans to develop the proposed site, the polluted dredged sediments could be disposed of in the lake.

2.000 ENVIRONMENTAL SETTING

2.100 Geographic Setting. Big Bay is in a region of sandy beaches with low bluffs, most predominant on the eastern shoreline of Big Bay. The west side of the bay is characterized by vertical bluffs of 30 to 100 feet in height. East of the east breakwater is a small reach of

critical erosion area. The entire region is covered by forests, except for the beaches, which, in this section of Marquette County, are of widths between 30 and 40 feet.

2.200 Physical Environment.

2.210 Climate. The Lake Superior Basin has a typical humid continental climate characterized by cold, dry winters and warm, humid summers. However, the lake exerts a strong micro-climatic influence on the immediate shoreline generally resulting in cooler summers and warmer winters than those experienced a few miles inland. Due to the differential heating of land and water (particularly a body of water as large as Lake Superior), the lake heats and cools more slowly than the land. Even during the coldest winters, Lake Superior seldom freezes over completely and air masses moving across the open water may be warmed 15 to 20 degrees.

2.211 As these lake-warmed winds cross the land, they moderate the sub-freezing land temperatures. This warmth, however, is soon dissipated by contact with the cold land surface. Conversely, in the summer, the lake is cooler than land temperatures and shore or near-shore stations will have summer temperatures 20 to 40 degrees lower than stations a few miles inland. The mean annual temperature is about 41 degrees F; average January and July temperatures are approximately 15 and 65 degrees respectively.

2.212 Precipitation occurs throughout the year and averages about 31 inches (1931-60). Precipitation is of low intensity with few hard rainstorms. The combination of cool summer temperatures and the proximity of the Lake Superior water mass result in an average humidity of 70 to 80 percent despite the moderate rainfall. Some of the high humidity results from inversion fogs that occur on or near the lake most of the year. The prevailing winds are westerly, with a mean velocity of 9 miles per hour. Wind velocity exceeds 30 mph an average of 30 days during the 5-month (May to September) small craft boating season.

2.220 Geology and Topography. The area around Big Bay Harbor was shaped during the Pleistocene glaciation. During this period successive ice sheets advanced and retreated across the area filling valleys, creating valleys and lakes, eroding hills, and depositing glacial till in various places.

2.221 The topography in the immediate vicinity of the harbor is relatively flat, but a mile or so inland there is an abrupt rise at the base of the Huron Mountains. Big Bay lies on the dividing point between the Laurentian Shield and the Michigan Basin. The Laurentian Shield is characterized by igneous and metasedimentary rock. The Michigan Basin exhibits bedrock with a gentle slope and a relatively smooth bedding (the bedrock is sedimentary). The dominant rock type in Big Bay is the Jacobsville sandstone of lower Cambrian or upper

Precambrian age interspersed with occasional outcrops of gabbro. The Jacobsville sandstone is generally arkosic (formed by the consolidation of debris derived from a mechanically weathered granite) but in some areas is almost pure quartzite.

2.222 Southeast of Big Bay is Lake Independence, a relatively large lake having approximately 5 square miles of surface area (see exhibit 5).

2.230 Soils. All of the soils in the Peninsula, including those in the Big Bay Harbor area, have developed from glacial drift and glacial lake deposits. These range from a few inches to several hundred feet in thickness. The topography is directly related to these deposits but wherever the drift is thin or absent, the topography is controlled by the bedrock. Soils are not always representative of the underlying material as drift may have been brought in from sources some distance away and subsequently deposited. There are three major soil associations in the vicinity of the harbor: Shelldrake; Onota-Onota wet variant; and Gogebic-Keweenaw-Kalkaska.

2.231 South of the harbor there is about one-half mile of Shelldrake association. This association is characterized as being moderately deep, well drained, sandy, and on moderately sloping topography (0-8 dominant slope range). Available water capacity is low and permeability is very high. It is poor to fair for agriculture and forestry because of a tendency toward dryness. Pollution of shallow groundwater is a hazard because of the high permeability. The proposed disposal site lies in this area.

2.232 Further south of the Shelldrake area, at the base of the Huron Mountains, is the Onota-Onota wet variant association. This consists of shallow, well to poorly drained, loamy or sandy soil on level to moderately steep topography. Natural fertility is medium to low as is available water capacity; permeability is rapid to slow. Both agriculture and forestry are poor to fair because of shallowness and wetness.

2.233 Distributed throughout the area are small deposits of Gogebic-Keweenaw-Kalkaska association. This association is a deep, well drained, sandy to loamy soil found on level to strongly sloping topography (dominant slope range 2-18). Natural fertility and available water capacity are medium to low and permeability is moderate to rapid. Use for agriculture and forestry ranges from poor to good with the stoniness and slope presenting obstacles. In the Kalkaska series of the association, pollution of shallow ground water is a hazard because of high permeability.

2.300 Hydrologic Environment

2.310 Lake Water Quality. The open waters of Lake Superior are of generally high quality and have not been greatly changed by human activity. The eutrophication process is apparently progressing at a very slow rate, but the measured changes in water quality are misleading when viewed from the eutrophication standpoint alone. The effect of human activity on Lake Superior could be more readily seen in the examination of other chemical and physical parameters.

2.311 The introduction of halogenated hydrocarbons is recent and a function of human activities. At present there is virtually no information on the levels of these compounds in Lake Superior. Measurement of these parameters is important because of the deleterious effects of the parent and breakdown products. The presence of heavy metals, taconite tailings, and asbestos-like material is acknowledged although their effects are still undetermined.

2.312 Lake Superior, the dominating body of surface water in the area, is characteristically soft water. Hardness is approximately 44 ppm C_aCO_3. The pH is approximately 7.5. Water temperatures in Lake Superior fluctuate slightly ranging from 40 to 50 degrees F most of the year.

2.313 Shipping has been responsible for minor water quality degradation in the open waters and harbor areas of Lake Superior. Oil discharges, bilge wastes and garbage from commercial vessels plying the lake have created problems from time to time.

2.320 Harbor Water Quality. In order to permit comparison between and within specific areas of the harbor, the harbor has been arbitrarily subdivided into four zones (see exhibit 6). Zones 1, 2, and 3 are dredged areas. Zone 1 is the harbor basin. Zone 2 is lakeward from the harbor basin. Zone 3 is the area between the breakwaters. Zone 4 is the undredged area outside of the breakwaters. The water quality data in general reflect the movement of water masses within the harbor and the contribution of shore-based activity to the water of the harbor. This is in agreement with the results of the chemical analyses of bottom sediments, which indicated that shore-based activities had a strong influence on the chemical character of the bottom sediments (see exhibits 6 and 7, pages A-9 - A-11, A-17 - A-21).

2.321 Zones 1 and 2 of the project area (see exhibits 2, and 4) are considered polluted because levels of lead, oil and grease, mercury, total volatile solids, chemical oxygen demand and total nitrogen exceed EPA criteria for levels of chemicals and heavy metals (see exhibit 7).

2.322 Dissolved oxygen (DO) levels were generally high in all zones sampled. The DO was usually at saturation levels for the water temperature at the time of sampling. Temperature values reflect the time of year in which the samples were collected. The pH values of the water samples in the harbor are slightly on the alkaline side. The highest turbidity values were obtained in zone I (the isolated area near the marina). Water turbidity decreases with distance from Zone I. Conductivity values are nearly the same throughout the harbor. Zone I had a slightly higher value than the other zones, due to the effect of the marina and run-off in that area.

2.323 Sediments. The Environmental Protection Agency (EPA), National Biocentrics, Inc., (NBI) and Michigan Technological University (MTU) sampled Big Bay Harbor for characteristic chemical constituents, benthic organisms, and particle size. (EPA analyzed for chemical constituents only). (See data in exhibits 6 and 7, pages A-9 - A-16.)

2.324 There is no industry or municipality which would contribute pollutants to the harbor. The primary influences in the harbor are the recreational boating activity and the influence of Lake Superior. Recreational boating contributes oils, grease, organic material, nutrients, and heavy metals to the waters of the harbor. These materials can settle to the bottom and become mixed with and incorporated into the bottom Sediments. The influence of Lake Superior is primarily in providing movement of water into and out of the harbor.

2.325 The silt and clay type particles found in Big Bay Harbor, although limited, are the sized particles which readily bind chemically with the organic and metal constituents found in the sediments. It has been observed that samples which contain high levels of organic and metal parameters are composed primarily of silt and clay-sized particles. Because of the fine nature of these particles, there is an increased number of sites available for physical and chemical binding with the organic and metal compounds. If these chemical compounds are present in the water, and come into contact with the sediment as a result of wave action or boat traffic, the result is that the silt and clay sized sediments will absorb higher levels of the chemicals from the water than will coarse (sand) sized bottom sediments. The result is a higher concentration of heavy metals on the surface of the bottom sediment than would normally appear.

2.326 Bacteriological Analyses. There appear to be no inter-zonal relationships among the total or fecal coliform values. Counts of both total and fecal coliforms were quite low in all instances and are indicative of the bacteriologically clean nature of the water present in the harbor and the lake beyond the harbor mouth. (See exhibits 6 and 7, pages A-9 - A-11.)

2.327 There was a tendency for some of the surface samples to have higher coliform counts than did corresponding bottom samples. This is not unexpected, because the bottom water is cold Lake Superior water, while the surface water probably has its origin as surface runoff. A small stream flows into the harbor near the marina. This would primarily affect Zones 1 and 2 where the differential surface and bottom values were in fact most evident.

2.400 Biological Environment

2.410 General. The shoreline of Lake Superior is a composite of beaches, boggy areas, and upland forests. These areas provide habitat for a variety of fish and wildlife species.

2.420 Terrestrial Vegetation. Inland from the harbor the forest on the better-drained land is primarily northern hardwood of the sugar maple, elm, yellow birch and hemlock variety. High proportions of aspen, fir, spruce and white pine are also found. In the wetter upland areas red maple, ash, alder and willow are found.

2.421 On the lowland area east of Big Bay Harbor, the dominant vegetation is fir and spruce. This probably results from the microclimate created by onshore winds.

2.422 Except for scattered remnants, most of the forest is second growth that has resulted from cutting practices used in harvest of the original forest oriented toward past economic conditions rather than present concern for sustained yield. Intolerant and short-lived species (such as jack pine, aspen, and birch) became established over a wide area following cutting and fires. They commonly occur on sites not suitable for the more desirable species. Because of the second growth situation over much of the area, most of the valuable hardwoods are in sapling or pole size classes and will not reach log or veneer dimensions for some years.

2.430 Benthos. Nineteen ponar samples of sediment from Big Bay Harbor were examined for benthic animals. In an effort to determine the effect of Corps of Engineers dredging on the numbers of benthic animals, 9 of these samples were collected from dredged areas and 10 from undredged areas. Since this entire harbor has been dredged, the undredged samples were collected outside the harbor in Lake Superior. *(See exhibits 6 and 7, pages* A-9 - A-11, A-22, A-23.)

2.431 In the 19 samples there was an average of 10.0 individual benthic organisms per sample with an average of 1.21 kinds of organisms per sample. The average number of organisms per sample found in the dredged area was 15.1, and in the undredged area the average number of organisms per sample was 5.4.

2.440 Plankton. The plankton levels of Lake Superior are sparse and dominated by forms characteristic of cold deep lakes. Recent studies show that diatoms are the most abundant plankton groups. (See exhibits 6 and 7, pages A-9 - A-11, A-24, A-25.)

2.441 The dominant phytoplankton in June was Asterionella, with subdominance exhibited by Synedra. In August a dominance shift occurred, and Dinobryon became the dominant phytoplankton. These findings agree with earlier studies of Lake Superior phytoplankton.

2.442 Zooplankton were scarce at both sampling times. Daphnia was the predominant species of zooplankton.

2.450 Fish. There is an excellent sport fishery at Big Bay and the surrounding area, where the best sport fishing is during the spring and fall months. The catch is primarily made up of Salmonids including

lake trout, rainbows, coasters (lake run brook trout), brown trout and, more recently the coho and chinook salmon. Because the salmonids are migratory their presence or absence in Big Bay is determined by temperature, time of year, physiology, and movements of prey and predator species (see exhibit 8).

2.451 There are two known spawning sites for lake trout in the Big Bay area (see exhibit 5). There is also a considerable population of whitefish in Big Bay which probably use the lake trout spawning area around Big Bay Point. Little information is available on the spawning stocks of chubs or herring in this area. However, the chubs apparently spawn deeper than 30 fathoms and the herring spawn somewhere from 5 to 60 fathoms.

2.452 A commercial fisherman operates out of Big Bay Harbor 2 months out of the year. The largest percentage of the catch is made up of white fish and chubs. Commercial fishing in Lake Superior is on the decline.

2.460 Wildlife. The adjacent forest provides habitat for diverse songbirds, birds of prey and upland gamebirds. White-tailed deer, black bears, coyotes, foxes, skunks, porcupines, squirrels, mice and many other mammals occupy the inland forest.

2.470 Rare and Endangered Species. A check with the State Department of Natural Resources and the Federal Bureau of Sport Fisheries and Wildlife has failed to disclose the existence of endangered species in the harbor area.

2.500 Socioeconomic Environment

2.510 Historical/Archaeological. The most recent listing of the National Register of Historic Places lists no sites located at Big Bay Harbor. The Michigan State Historical Society and the Michigan State Archaeologist have been consulted regarding the harbor (exhibit 9). A submerged ruin, probably dock pilings, exists along the shoreline about one-fourth mile north of the harbor (see exhibit 2). The Marquette County Historical Society and the Architectural Heritage Committee at Marquette have been contacted regarding this matter (see exhibit 10, pages A-34 - A-36). The site of the ruin is out of the project area and would not be affected by Corps of Engineers breakwater maintenance dredging or dredged material disposal. The Michigan State Archaeologist has advised that a 1-day pit test be made at the proposed disposal area (see page A-32). This test will be accomplished in June 1975.

2.511 Historic Background. Big Bay Harbor is completely artificial and was constructed in 1960. It has no historic connection or relationship with the nearby village of Big Bay or with Powell Township, in which it is located.

2.520 Socioeconomic Characteristics. Powell Township has a population of 372, most of whom live in the community of Big Bay, located south of the harbor. The population has decreased some 4.6 percent since 1960 when it had 390 people. Much of the township is owned by the Huron Mountain Club, a private resort. It provides some employment for plumbers, electricians, carpenters, groundskeepers, etc. In Big Bay itself, there are two general stores, a service station, an antique dealer, and a gift shop. Many of the people who reside in the township are retirees.

2.521 There are no separate statistics for employment in the township but local officials indicated that many of those employed commute to Marquette or to the iron mines further south in the county.

2.522 Powell Township is governed by a town supervisor and town board, all of whom are elected. The town owns a small park in Big Bay, containing a ball field and picnic tables. In addition, the town has acquired property on Squaw Beach for development of a park. The Powell Township School, located at Big Bay, has approximately 75 pupils in grades kindergarten through 8. Some 30 high school students are bussed to Marquette.

2.523 Commercial fishery associated with Big Bay Harbor is extremely limited (see paragraph 2.452).

2.524 Because Big Bay Harbor is located in close proximity to the city of Marquette (1970 population: 21,967) utilization by sport fisherman will probably continue at present levels or increase slightly.

2.600 Future Environmental Setting Without the Project. Without a maintained project, storm generated waves and longshore currents would continue to shift and redeposit sand in the harbor entry, eventually blocking it. Storm generated wave activity would in time destroy the breakwater. Although these processes resulting from no project would, because of the nature of the harbor site, be slow to occur, eventually the loss of the breakwater and the harbor entry shoaling would close the harbor.

2.601 Fishing craft and recreational craft would probably be able to continue using the harbor for some years. In terms of economic impact, there is no commercial activity (only an already very limited commercial fishery) which would be damaged by closure of Big Bay Harbor. However shoaling would eventually result in the closure of the only harbor-of-refuge on the 71-mile stretch between Presque Isle Harbor and the Keweenaw Waterway.

2.602 If the Corps of Engineers were to halt dredging activities in Big Bay Harbor but private interests were allowed to dredge, it is difficult to assess what the effect would be. The cost of maintaining the harbor at its present depths as a harbor-of-refuge would probably be prohibitive. It is doubtful that private interests would be willing to bear the cost.

3.000 RELATIONSHIP OF THE HARBOR TO FUTURE LAND USE

3.100 Harbor Facilities. Facilities at Big Bay Harbor include six to twelve accommodations for transient boaters, gasoline, water, electricity, showers, restrooms, holding tank pump-out, and telephone.

3.101 The physical geography of the harbor created by dredging operations at Big Bay has promoted the development of docks, piers, and other support facilities for boating activity adjacent to the harbor.

3.200 Land Use of Dredge Material. Dredge material has been used for land fill in the area directly behind the harbor which is Marquette County property. Materials dredged from the unpolluted portion of the harbor are periodically used for beach nourishment on the eroded shoreline east of the harbor.

4.000 PROBABLE IMPACT OF THE PROJECT ON THE ENVIRONMENT

4.100 General. Maintenance is conducted as necessary. Certain amounts of oil and grease may reach the water directly as a result of equipment submersion. Reasonable care is maintained to prevent oil and grease from entering the water, however oil slicks may occur in the vicinity of operating equipment. A floating oil boom is stored at the Fountain City Wisconsin boatyard and is packaged to be transported to any Lake Superior site to clean up accidental oil spills. Adverse effects on air quality may result, as diesel exhaust must be vented into the open air, however these effects would be short-term in duration.

4.200 Impacts of Breakwater Maintenance.

4.210 Noise. A certain amount of noise is associated with the operation of the various motors, pistons, winches, etc., in those pieces of equipment performing breakwater and pier repair. Little of the noise associated with the equipment is audible beyond several hundred feet distance and occurs only during hours of operation, thus noise does not constitute a significant adverse effect.

4.220 Activity Related Congestion. While moving to and from the repair site, the repair vessels may cause a minimal amount of channel blockage. The equipment is usually moored to the breakwater out of navigation channels, while repairs are taking place.

4.230 Impacts of Structures

4.231 Biological Impacts. Permanent structures, such as the breakwaters and revetments introduce wood, metal, concrete, rubble and rock to the

water where none existed previously. Breakwater along the relatively unsheltered coastline not only provide an area of calm water for navigational purposes, but also provide a relatively calm and sheltered habitat for species which would normally not be found in this area. Increases in macrophytes, plankton and benthic species can be expected in areas of reduced wave force. As the habitat changes and nutrient levels increase, increases may also occur in kinds and numbers of fish present.

4.232 Chemical Impacts. The building and physical presence of structures such as breakwaters, revetments, docks and navigational aids constructed of materials foreign to the area or the harbor, have certain concomitant and potential chemical impacts upon the aquatic harbor environment. Breakwaters and revetments may contribute trace amounts of various chemicals as a result of leaching of native rock or concrete after long submersion in the water. Revetments, which use treated or galvanized steel pilings, may contribute zinc and small amounts of lead, cadmium, and iron. Painted or electrified navigational aids on breakwaters, piers and docks may contribute lead, zinc, copper and other elements as they age and/or deteriorate under constant exposure to weathering.

4.300 Impacts of Dredging. Dredging in Big Bay Harbor involves the use of the MARKUS, together with tug boats and bottom dump scows. Bottom sediments are physically scooped up and placed in barges which are moved by tugs to dump sites.

4.310 Turbidity. The MARKUS operates by dropping its bucket into the bottom and scooping out bottom sediments. The act of dredging, by its very nature, creates a certain amount of turbidity (muddied or sediment clouded water). Lifting a load of sediments out of the water also causes turbidity as "mud" washes out of the dredge bucket.

4.311 Turbidity affects the amount of light penetrating into the water. Reduction of light penetration is of relatively short duration with little effect upon the light requirements of sensitive organisms.

4.312 Turbidity also effects resuspension, redistribution, and related solubility-accelerated oxidation or reduction of various oils and grease and heavy metals such as lead, zinc, mercury and copper. All of these substances are toxic to life forms, although it is as yet not fully known to what extent turbidity caused by dredging influences their concentrations.

4.320 Water Contamination. All of the operating equipment associated with the MARKUS is equipped with sanitary holding tanks for containment of onboard generated wastes. A certain amount of water quality impairment results from dredging-induced turbidity, discussed above.

4.330 Noise. Noise associated with operating the dredge is substantial. The use of this equipment generates considerable mechanical noise associated with the raising and lowering of the dredge bucket. This noise impact is relatively short-lived being associated with the act of dredging during hours of operation.

4.340 Activity Related Congestion. The act of dredging results in the location of the dredge, scow, barges and other large pieces of equipment directly in the entry or channel. As such, it presents a navigational obstacle by the mere presence of large stationary vessels. In a small harbor such as Big Bay, this localized center of equipment may cause congestion problems.

4.350 Chemicals. As previously noted, sediments in the innermost portion of Big Bay Harbor are polluted according to EPA criteria. EPA analysis indicates that the harbor basin and inner entrance channel are polluted by excessive levels of Total Volatile Solids (TVS), Total Kjeldahl Nitrogen (TKN), Chemical Oxygen Demand (COD) and oil-grease. Dredging with its concomitant disturbance of bottom sediments, causes a temporary resuspension of some of the fine particles as discussed in paragraphs 4.310 to 4.312.

4.351 Heavy metals tend to be concentrated in the layer of fine sediment covering the bottom; this is discussed in detail in paragraph 2.325.

4.352 Dredging usually removes from 1 to 3 feet from the top of the accumulated sediments in the harbor bottom. Removal of potentially toxic (in the case of heavy metals or some organics) or oxygen-demanding material can be a desirable chemical (and eventually biological) impact on the harbor environment.

4.360 Biological Impacts. Sampling has disclosed that more benthic organisms are found in areas of the harbor which have been dredged than in areas that have not been dredged. This is not unexpected because undredged samples were taken in Lake Superior and dredged samples were taken in the harbor where there is a rich organic substrate, rather than clean sand. (See paragraph 2.431).

4.370 Habitat Alteration. By dredging to a depth of 10 feet at Big Bay Harbor, a totally different sediment would be exposed which would have different characteristics than the one which previously existed at the sediment-water interface. It would be expected to establish and sustain a different benthic community.

4.371 The total number of benthic organisms may return relatively rapidly; but the symbiotic relationships between various species indicate that a new or different equilibrium point may be reached soon after dredging and that it may take a long time (years) before a mature or stable benthic community reestablishes itself. Periodic dredging would however preclude the establishment of a stable benthic community.

4.380 Organic Matter Removal. The bottom at the sediment-water interface is characterized by fine clay and silt sized particles which tend to be high in both organic and inorganic matter. These particles tend to be both chemically and physically active. Decay of organic material tends to produce an anoxic (oxygen depleted) condition at the water-sediment interface. The anoxic condition at, and slightly above, the interface, results in anaerobic (in the absence of oxygen) decomposition of the organic and other matter in the sediments. This will cause a temporary reduction in the amount of dissolved oxygen in the harbor water and an increase in the chemical oxygen demand. The waters of Lake Superior which readily interchange with the harbor water are normally high in dissolved oxygen throughout the year; it is therefore, unlikely that temporary changes in the oxygen demand of the harbor water will have a significant impact on fish habitat.

4.390 Socioeconomic Impact. It is impossible to estimate accurately the dollar value of losses prevented by the breakwaters, but the existence of the breakwaters is crucial to the harbor-of-refuge concept. If entry to a harbor-of-refuge during a storm is deemed a danger, the harbor-of-refuge is not likely to be used. This would defeat the purpose of maintaining harbors-of-refuge.

4.400 Impacts of Dredged Material Disposal. Beach nourishment using sand dredged from the harbor was practiced through August 1974. All dredging that has taken place since the inner harbor was declared polluted, has been in the outer harbor areas which are classified non-polluted. Dredge material from the most recent operation was used to increase the beach on the east side of the east breakwater. The majority of the dredging in the next 10 years is anticipated to take place in that portion of the harbor classified as non-polluted (see paragraph 1.730).

4.410 Open Water Disposal

4.411 General. Open water disposal creates turbidity in the disposal area (see discussion of turbidity, paragraphs 4.310-4.312). In addition, open water dumping results in the burial, en masse, of the benthic organisms present in the disposal area, and of fish eggs and larvae (if disposal is in a spawning area).

4.412 Potentially Harmful Materials. Open lake disposal brings potentially detrimental materials, presently isolated within the sediments of the harbor temporarily into intimate contact with the high quality water of the open lake. The degree of impact on water quality depends on the amount of detrimental material in the dredged sediment. (As mentioned, only about 2,000 cubic yards of polluted material would be disposed of in the next 10 years.) Short-term changes in physical water quality in or near the dump zone may result from sediment particles being suspended in the water. Short-term localized sediment clouds in the water may have a temporary effect upon fish in the area.

4.413 Disposal of highly organic dredge material in an open water dump zone can result in organic sediment trails causing a localized, relatively short-term decrease in dissolved oxygen as the (probably) anaerobic sediments begin aerobic decay in the highly oxygenated open lake water. This situation would result in a short-term repelling of fish until the turbidity has cleared.

4.414 Turbidity clouds would also disperse heavy metals, which had been bound with the sediments, throughout the disposal area. At present it is known that heavy metals are toxic to life forms in varying ways and degrees. But it is not known in each case how heavy metals in dredged material may affect harbor or open lake ecology. The heavy metals may be picked up by plankton and subsequently passed from organism to organism in the "food chain".

4.415 Open lake disposal, with its concomitant resuspension of sediment material, would increase the concentration in the water of whatever chemicals are found in the dredged sediment, resulting in a detrimental effect on water quality in the disposal area. Such an impact is dependent upon the quantity of these chemicals in the disposed material. Nutrients released in the water as a result of dredged material disposal may, on the other hand, spur an increase of planktonic growth which in turn attracts fish.

4.420 Beach Nourishment. Beach nourishment is utilization of the sand, gravel, and stone dredged from the harbor in a practical manner representing a recycling of a valuable natural resource. However, as the dredged material would be dumped just offshore at a depth of approximately 8 feet, the impacts of this disposal method would be much the same as those of open lake disposal, discussed above. This method of disposal would subject any potentially detrimental materials contained in the sediments to redistribution by waves and long shore currents. Present plans are for using only sediments dredged from the non-polluted areas as beach nourishment.

4.430 On-Land Disposal. Diked or confined disposal is the generally recommended method for disposal of polluted sediments. The proposed disposal method (see paragraphs 1.731-1.734) for the 2,000 cubic yards of polluted sediments dredged from Big Bay Harbor is confined in the sense that the dredged material would not re-enter the harbor or lake. Much of the water and suspended pollutants associated with the polluted dredged sediments would already be lost when the material is handled during transfer and spreading on the site.

4.431 As the average depth of dredged material deposited in the area would be less than 9 inches, run-off would not be a significant problem. If necessary in order to prevent the return of the polluted sediments to the harbor, a mound of earth (consisting of the material existing in the area) would be pushed up to form a berm around the perimeter of the disposal area.

4.432 The soil in the disposal area is highly permeable being largely comprised of sand. However, due to the small amount of polluted sediments being dredged and due to the distance of the disposal site from the harbor

(approximately 100 feet), it is unlikely that a significant amount of pollutants would return to the harbor through seepage or as run-off.

4.433 Benefit-Cost Considerations. Plans for a clay-cored containment facility have not been developed for Big Bay Harbor. Experience at Duluth-Superior Harbor indicates that with on-land disposal, costs run about 5 dollars per cubic yard. The cost of constructing a clay-cored containment facility may add 4 to 5 dollars per cubic yard so that the total cost may amount to 10 dollars per cubic yard. The cost of dredging when in-lake disposal is permitted is approximately two dollars per cubic yard and perhaps 50 cents more when beach nourishment is anticipated.

4.434 Noise. A certain amount of noise associated with disposal equipment and activity would result. Such potential motor and related noise would not, however, create any special problems (see paragraphs 4.210 and 4.330).

5.000 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

5.100 Dredging.

5.110 The physical act of digging a hole in the harbor bottom under water causes several unavoidable effects, the most obvious of which is turbidity (see paragraphs 4.310 - 4.312). Turbidity also results from overflowing and leaking dredge buckets, clam-shells, and dump scows. Additional turbidity results when equipment and scows are cleaned by flushing sand, mud, silt and organic material off decks and operating equipment with high-pressure water hoses.

5.111 More subtle effects are those produced upon aquatic life and upon water quality in the area of the operating equipment. Turbidity clouds and associated release of oxygen-consuming material, especially where dredging of organic sediment is being conducted, can be expected to reduce the dissolved oxygen level of the surrounding water. Those same releases result in higher plankton levels and a higher biomass.

5.112 Aside from turbidity-influenced effects, the physical act of digging and disrupting the habitat of various benthic dwelling organisms must be considered an unavoidable effect of the dredging operation. Fish are mobile and are able to swim out of the way of the dredge scoop or clam-shell. Benthic dwelling organisms such as bacteria, fungi, molluscs, insect larvae and crustacea must be considered as relatively immobile and subject to being dredged with their habitat.

5.200 Disposal.

5.210 Open Lake Disposal. An unavoidable effect of open water type of disposal is the burial, en masse, of benthic dwelling organisms under the load of dumped sediments. In cases of off-shore disposal, as with dredge-induced turbidity, the nutrients released to the water may spur an increase of plankton.

5.220 On-Land Disposal. Present plans are to dispose of the polluted dredged material on land and not construct a clay-cored confinement facility (see paragraphs 4.430-4.432). Although the polluted sediments are expected to be prohibited from returning to the harbor or entering the water table the facility would not chemically trap the pollutants contained within the sediments. The disposal site is comprised largely of sandy soils. Although leaching of the pollutants into the harbor and water table is a possibility, as mentioned, the amounts of polluted sediments to be deposited on the disposal site is very small (2,000 cubic yards) and the amount of pollutants associated with these sediments would be minimal after transfer from the harbor to the disposal site (see paragraph 4.430).

6.000 ALTERNATIVES TO THE PROPOSED ACTION

6.100 Disposal Alternatives.

6.110 Open Lake Disposal. As mentioned EPA would allow open lake disposal of sediments dredged from both the polluted and unpolluted portions of Big Bay Harbor (see exhibit 10 page A-40).

6.120 Beach Nourishment. Beach nourishment in 8 or less feet of water is a feasible solution for the disposal of material dredged from Big Bay Harbor.

6.121 Since construction of the breakwater in 1960, the beach east of the breakwaters has experienced considerable erosion. An inspection of the area in October 1970 revealed that the beach has been affected for approximately 1 mile east of the harbor, and in several places the shoreline has retreated 100 feet. Dredge material, which is mostly sand, could be used as beach nourishment in this area.

6.200 Use of Polluted Dredged Sediments as Construction Material. The Marquette County Board of Road Commissioners has expressed interest in using the dredged material for construction purposes, however no requests have been made to date.

6.300 No Project. As stated, Big Bay Harbor is the only small craft harbor-of-refuge between Marquette, Michigan and the eastern entry to the Keweenaw Waterway, a straight line distance of 71 miles. In addition to providing a refuge from storms, it affords public access to an excellent sport fishery. Although human lives and the recreational value of the harbor cannot be placed on a monetary scale they should receive careful consideration before a no-project alternative is implemented.

6.400 Alternative Disposal Sites. No alternate disposal sites are currently under consideration.

6.500 Remedial, Protective, and Mitigative Measures.

6.510 Erosion. Northern Michigan University, Marquette, Michigan is presently contracted by the Corps to study the shoreline processes of Big Bay. This study will give the Corps data to determine whether additional projects are needed to abate the erosion of the beach of Big Bay Harbor.

7.000 RELATIONSHIP BETWEEN SHORT-TERM USES OF NATURAL ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

7.001 The propriety of Corps of Engineers maintenance activities in Big Bay Harbor must be weighed against the potential damage incurred to the human life support system - the biosphere - thereby guarding against the short-sighted foreclosure of future options or needs. Past, present and proposed actions and their associated detrimental and beneficial impacts must be considered not only in relation to the specific harbor area affected but also to the greater area and public served by the project.

7.002 Corps of Engineers maintenance activities in Big Bay Harbor are conducted by Congressional authority in response to expressed and implied public need for continued small craft navigation and safety requirements within the project area. Breakwater repair and inner basin dredging is performed on a periodic basis as needed, in response to changing harbor use patterns and in response to storm-generated breakwater damage and basin shoaling.

7.003 In pursuit of the requirements for harbor maintenance, some localized short-term expenditures of funds, manpower, and natural resources have occurred. Localized short-term disruptions of the benthic biological community have occurred but no apparent long-term damage has resulted from past Corps dredging or structure maintenance at the harbor. It is possible that the breakwater structures may be a contributing factor in the shoreline erosion east of the harbor, however future maintenance dredging and structure repair, if conducted essentially as in the past, should not constitute a long-term detrimental effect upon life styles, land use patterns or ecosystems in the Big Bay Harbor area.

7.004 Some localized short-term release of potential contaminants to the open waters of Lake Superior have occurred in the past during disposal of material dredged from the harbor, however, no apparent long term damage to any ecosystem has resulted from past on-land or open lake disposal methods. Future polluted dredged material disposal methods, if adhering to present plans, should not detrimentally affect the natural environment or associated harbor ecosystems.

7.005 Corps maintenance activity and the periodic expenditure of funds, manpower, and natural resources associated with that activity has permitted the continued use of Big Bay Harbor by those individuals who rely on the harbor for their recreation and safety.

7.006 Continued Corps maintenance of Big Bay Harbor, while resulting in irretrievable short term use and commitments of resources and temporary disruption of harbor benthic species within the project area, will allow the existence of harbor-related land use and life style options for present and future generations in the Big Bay community and surrounding South Shore area.

8.000 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

8.100 Breakwater Maintenance. Breakwaters and revetments at Big Bay Harbor are constructed of pilings, rock and concrete. All of the materials that go into either the construction or maintenance of any Corps of Engineers structures may be considered as permanently and irretrievably committed. All fuels and lubricating oils used by construction and maintenance machinery also constitute irretrievable commitments of natural resources.

8.200 Maintenance Dredging. The operation of dredging equipment, tugboats, tenders and other maintenance craft results in consumption of various quantities of petroleum products in relation to the frequency and duration of the maintenance dredging operation. All fuel consumed during maintenance dredging operations constitutes an irretrievable commitment of natural resources.

8.300 Dredge Material Disposal

8.310 In the Open Lake. Past operations have disposed of approximately 139,000 cubic yards of sand, silt, clay, and organic material in open Lake Superior. Of that material only the sand, which made up the predominant character of the material, could be considered a valuable natural resource which has for the most part been irretrievably lost.

8.320 As Beach Nourishment. At various times in the past dredged sand has been used as beach nourishment near the harbor. Beach nourishment is used to create recreational or habitat diversity or to replace private property lost to waves and currents.

9.000 COORDINATION

9.001 This report was drawn partially from an environmental impact assessment prepared by National Biocentric, Inc., under contract to the Corps of Engineers. Many meetings were held with National Biocentric and its subcontractors; the University of Minnesota, Duluth; University of Wisconsin, Superior; and Michigan Technological University, Houghton, to determine the scope and content of the assessment and to ensure adequate coverage of all Corps functions and their effect on Big Bay Harbor. Northern Michigan University, Marquette is under contract to the Corps to study shoreline processes and erosion taking place in Big Bay Harbor.

9.002 During the weeks of 9-13 and 16-19 of July 1973, representatives of National Biocentric, Inc.; the Corps of Engineers, St. Paul District and Duluth; the Environmental Protection Agency; the Fish and Wildlife Service; the Minnesota Pollution Control Agency; the Minnesota, Wisconsin and Michigan Departments of Natural Resources; as well as local administrative officials and interested parties, conducted a tour of all harbors on Lake Superior which are within the jurisdiction of the St. Paul District of the Corps of Engineers. The purpose of the tour was to familiarize the representatives of interested Federal, State and local governments and of the contracting agencies who were carrying out technical studies on specific harbors, with all of the harbors and the problems involved in dredging, dredge disposal and general maintenance of such harbors. It was hoped that as a result, the assessment parameters would be understood by all and that a coordination of effort might better be achieved.

9.003 The Michigan State Archaeologist, the Department of State Division of Michigan History, and the National Park Service Archaeologic Salvage Coordinator have been consulted regarding Big Bay Harbor. In addition two historical organizations in Marquette, Michigan have been consulted (see exhibit 9).

9.004 The Michigan Department of Natural Resources and the U.S. Environmental Protection Agency and the U.S. Fish and Wildlife Service has been consulted regarding Corps disposal plans for sediments dredged from the polluted and unpolluted portions of Big Bay Harbor (see exhibit 10).

10.000 CONCLUSIONS

1C.000 Based on the information contained in this assessment I conclude that the continued operation and maintenance of Big Bay Harbor is important to the health, safety, and social well-being of the residents fo the local area and other persons utilizing the facility as a harbor-of-refuge.

10.002 The adverse impacts of operation and maintenance activities are generally short-term in nature, and the social benefits resulting from the project far outweigh these short-term effects. However, in order that the Big Bay project remain desirable, and to reduce the potential environmental impacts, consideration will continue to be given to minimizing the impacts on fish and wildlife resources during all phases of maintenance and to reduce the return of polluted materials to the water following dredging and disposal.

10.003 Attention will continue to be given to preventing, controlling and removing any fuel spillage or oil slicks caused by dredging and harbor maintenance activities. Efforts will continue to be made to avoid spillage of sediment back into the harbor during dredging, loading and unloading of scows, cleaning of scows, and related activities.

10.004 Open lake disposal will be coordinated with the Michigan Department of Natural Resources and the U.S. Fish and Wildlife Service, so that dredged material is not dumped on spawning areas.

10.005 Public access and recreational opportunities for fishermen, bird watchers, photographers, and other users of the breakwaters, and adequate safety precautions and equipment will be afforded.

10.006 The proposed action will not result in the displacement of any persons or in the loss of any known cultural, natural, historic, or archaeological resources. A 1-day pit test of the disposal area will be made prior to any disposal on-land.

10.008 The environmental review by this office has indicated that the proposed action will not have a significant impact on the quality of the human environment.

10.009 Therefore, I conclude that these activities do not constitute a major Federal action which will significantly affect the quality of the human environment and it is my decision that an environmental impact statement will not be prepared for this activity.

Max W. Noah

20 May 1975

MAX W. NOAH
Colonel, Corps of Engineers
District Engineer

TECHNICAL

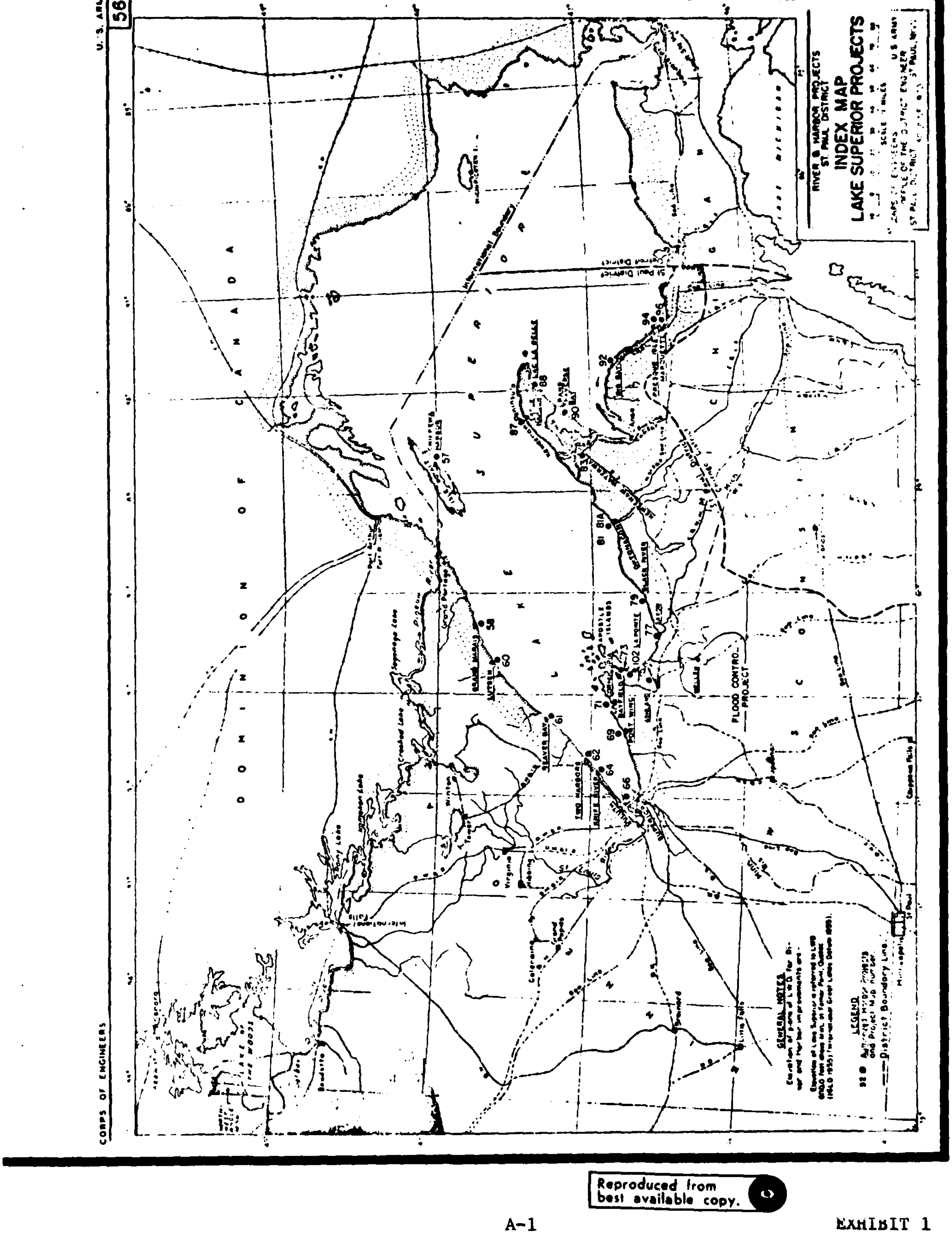
ST. PAUL DISTRICT, CORPS OF ENGINEERS

DEPARTMENT OF THE ARMY

ENVIRONMENTAL ASSESSMENT REPORT
OPERATION AND MAINTENANCE
AND HARBOR-RELATED SHORELINE EROSION
BIG BAY HARBOR
BIG BAY, MICHIGAN
LAKE SUPERIOR

TECHNICAL APPENDIX

TABLE OF CONTENTS



RIVER & HARBOR PROJECTS
ST PAUL DISTRICT
INDEX MAP
LAKE SUPERIOR PROJECTS
CORPS OF ENGINEERS
U. S. ARMY
56
DOMINION OF CANADA
LAKE SUPERIOR
FLOOD CONTROL PROJECT
GENERAL NOTES
LEGEND
District Boundary Line

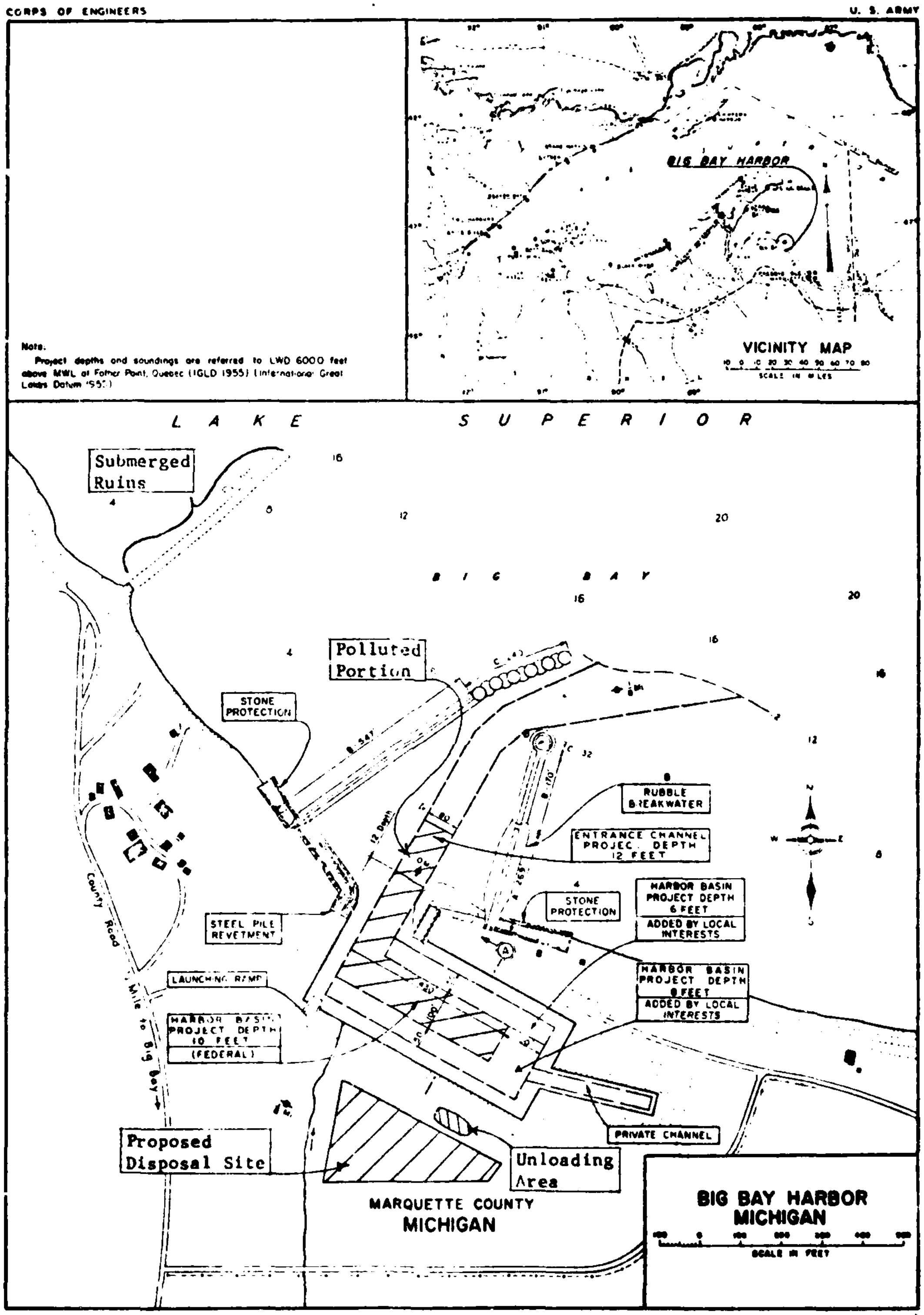

CORPS OF ENGINEERS
U. S. ARMY
Note.
Project depths and soundings are referred to LWD 6000 feet above MWL at Father Point, Quebec (IGLD 1955) (International Great Lakes Datum 1955)
BIG BAY HARBOR
VICINITY MAP
SCALE IN MILES
LAKE SUPERIOR
Submerged Ruins
BIG BAY
Polluted Portion
STONE PROTECTION
RUBBLE BREAKWATER
ENTRANCE CHANNEL PROJECT DEPTH 12 FEET
HARBOR BASIN PROJECT DEPTH 6 FEET
ADDED BY LOCAL INTERESTS
STONE PROTECTION
STEEL PILE REVETMENT
HARBOR BASIN PROJECT DEPTH 8 FEET
ADDED BY LOCAL INTERESTS
LAUNCHING RAMP
HARBOR BASIN PROJECT DEPTH 10 FEET (FEDERAL)
County Road
Mile to Big Bay
PRIVATE CHANNEL
Proposed Disposal Site
Unloading Area
MARQUETTE COUNTY
MICHIGAN
BIG BAY HARBOR
MICHIGAN
SCALE IN FEET

EXHIBIT 2

Big Bay Harbor Operations History

The following is a brief summary of Corps of Engineers activities in Big Bay Harbor from 1959 through FY 1975.

Year	Event Description	Cu. Yds. Removed	Costs $ New	$ Maint.
- to 1950	Authorization 1945-no work done			
1959	Detailed studies		$12,576	
1960	Contract const. of harbor	11,000	161,241	
1961	Misc. engineering harbor construction	90,000	120,052	
1962	Harbor expansion		46,483	
1963	Protection E. breakwater, bank surveys, misc. engineering			$15,034
1964	Dredging, bank protection E. breakwater, surveys	5,875		51,360
1965	Dredging, cond. surveys	10,775		17,006
1966	Dredging, cond. surveys	6,000		16,431
1967	Condition surveys, dredging	5,500		8,500
1968	Maint., breakwater and pier repair, surveys, dredging	17,320		46,878
1969	Pier repair, breakwater repair surveys, admn. costs			215,938
1970	Breakwater repair, surveys, admn.costs			55,060
1971	Cond. surveys, dredging,	3,750		15,960
1972	Cond. surveys, dredging, break-water repairs, erosion studies	3,750		33,329

EXHIBIT 3

Big Bay Harbor Operations History (Continued)

Year	Event Description	Cu. Yds. Removed	Costs $ New	Costs $ Maint.
1973	Maint. Dredging	6,750		$32,800
1974	Maint. Dredging (15 July-5 August)	5,360		14,400
1975	Maint. dredging			16,500
	Total cubic yards removed through 1975:	174,830		
	Total itemized costs through 1975:		340,352	539,196

EXHIBIT 3

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

Colonel Max W. Noah
District Engineer
Department of the Army
St. Paul District
Corps of Engineers
1210 U.S. Post Office and
  Custom House
St. Paul, Minnesota 55101

Dear Colonel Noah:

This is in reference to your letter of December 24, 1974 (NCSED-F) concerning Big Bay Harbor, Michigan.

We have re-evaluated our sediment data for this harbor, and based on the 1972 chemical analyses and field observations we have made the determination that only that portion of the harbor indicated by shading on the attached project map is polluted. The question of disposal alternative can, at this time, be influenced by the following factors:

1. Volume of material to be dredged - taking into account our new delineation, this should be broken down into polluted and unpolluted volumes and accompanied by a map (project) showing the shoaled areas.

2. Source of sediments which are shoaling in this project - inflow from creek or shore of Lake Superior.

3. Possible sources of contamination - list of dischargers in the area of dredging activity to include chemical characteristics of the discharge.

4. Availability of pumpout facilities for boats, and any information on compliance with associated State regulations.

5. More recent bottom sediment data which might be available.

In order to more properly make a determination on the spoiling of dredged material from this project, we suggest that you revise and update your letter report for Big Bay Harbor, Michigan to include information on the above listed factors as well as costs.

EXHIBIT 4

Dredged spoil can be considered a resource in certain cases. We hope that you keep this in mind during your disposal site selection process.

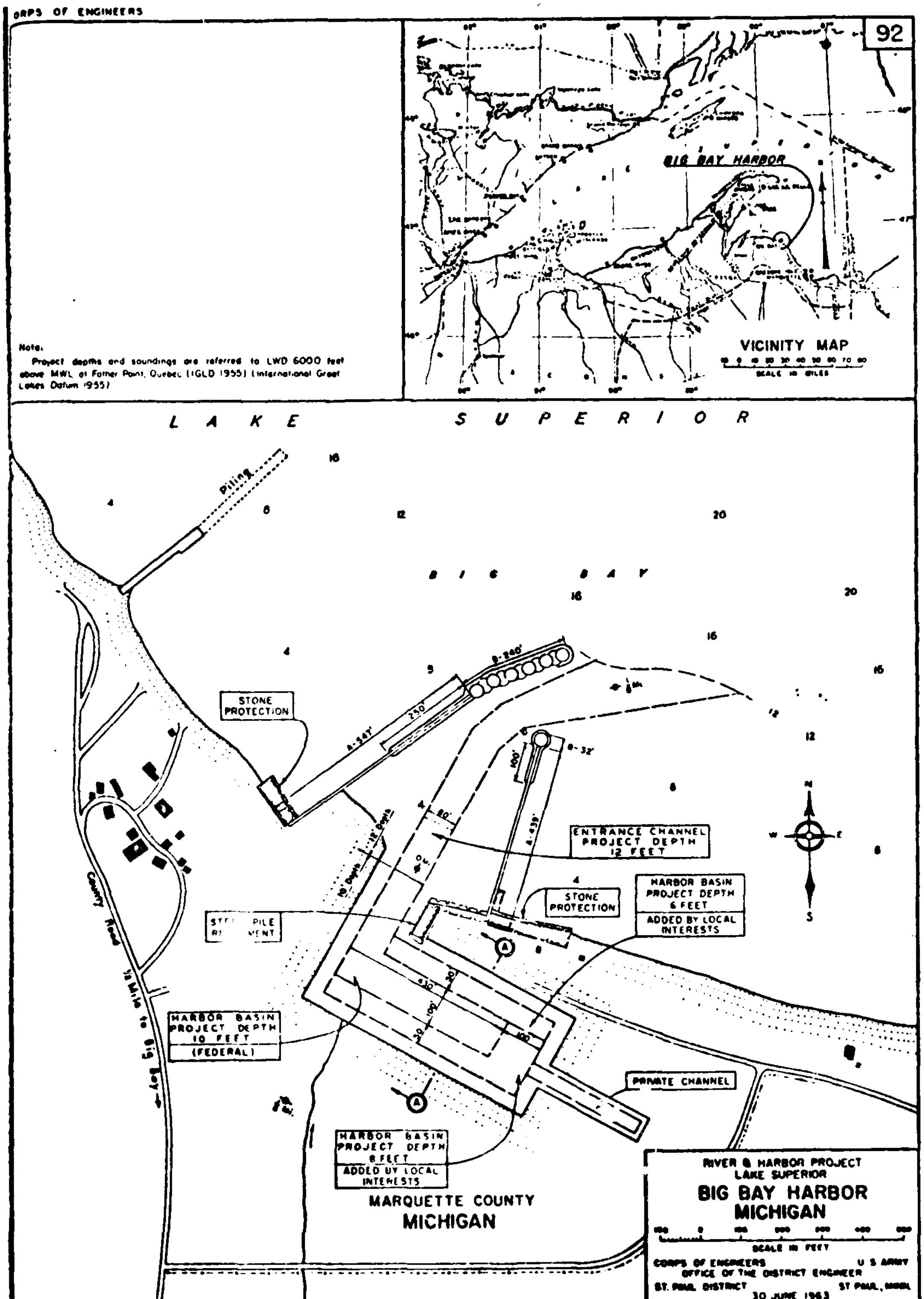
We wish to work closely with you on this and other projects in your district. If you need assistance or additional information, please feel free to contact us.

Sincerely yours,

Robert W. Zeller

Robert W. Zeller, Ph.D., Director
Surveillance and Analysis Division

Attachment



ORPS OF ENGINEERS
92
BIG BAY HARBOR
VICINITY MAP
SCALE IN MILES
Note:
Project depths and soundings are referred to LWD 600.0 feet above MWL at Father Point, Quebec (IGLD 1955) (International Great Lakes Datum 1955)
L A K E S U P E R I O R
B I G B A Y
Piling
STONE PROTECTION
ENTRANCE CHANNEL PROJECT DEPTH 12 FEET
STONE PROTECTION
HARBOR BASIN PROJECT DEPTH 6 FEET
ADDED BY LOCAL INTERESTS
HARBOR BASIN PROJECT DEPTH 10 FEET
(FEDERAL)
PRIVATE CHANNEL
HARBOR BASIN PROJECT DEPTH 8 FEET
ADDED BY LOCAL INTERESTS
County Road
1/2 Mile to Big Bay
MARQUETTE COUNTY
MICHIGAN
RIVER & HARBOR PROJECT
LAKE SUPERIOR
BIG BAY HARBOR
MICHIGAN
SCALE IN FEET
CORPS OF ENGINEERS U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT ST. PAUL, MINN.
30 JUNE 1963

EXHIBIT 4

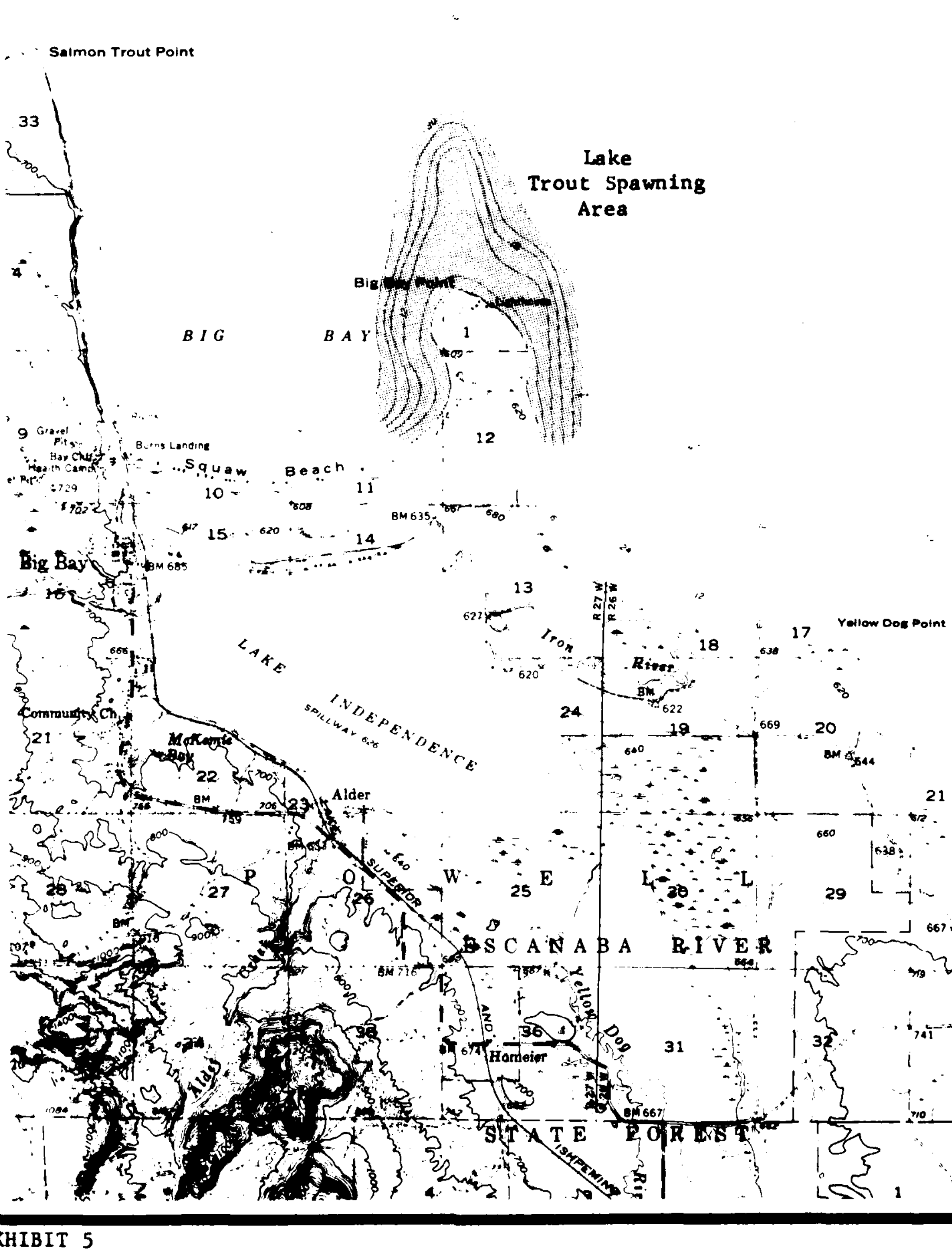
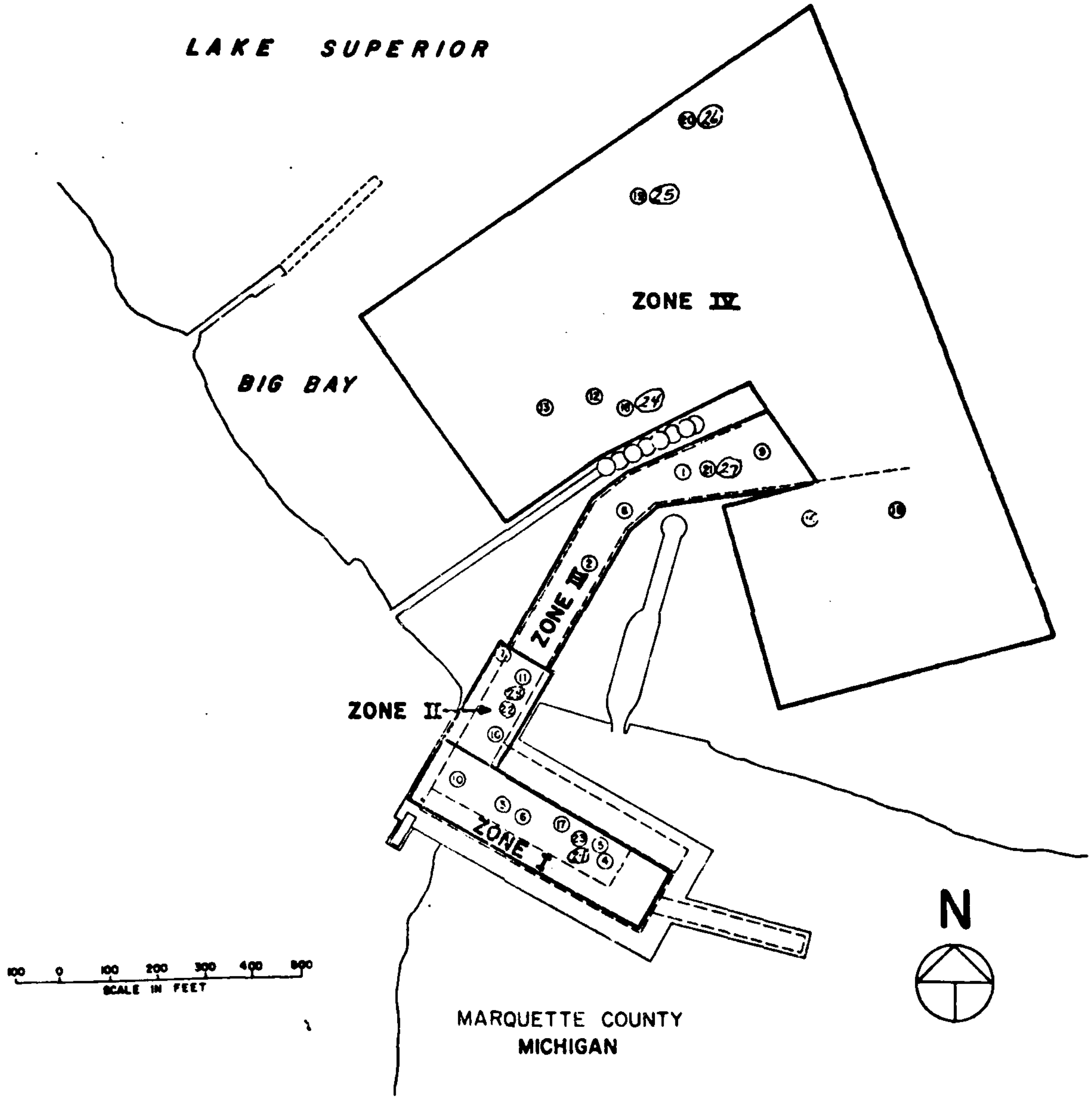

Salmon Trout Point
Lake
Trout Spawning
Area
BIG BAY
Big Bay Point
Squaw Beach
Burns Landing
Big Bay
LAKE INDEPENDENCE
SPILLWAY 626
Iron River
Yellow Dog Point
Community Ch.
McKenzie Bay
Alder
SUPERIOR
POWELL
ESCANABA RIVER
STATE FOREST
Yellow Dog
Homeier
ISHPEMING
BM 685
BM 635
BM 667
R 27 W
R 26 W

EXHIBIT 5

BIG BAY HARBOR
MICHIGAN



SAMPLING ZONES

EXHIBIT 6

The identification of specific samples within a zone in Big Bay Harbor.

ZONE	SAMPLE NUMBER	DATE COLLECTED	AGENCY
1	3	June 1970	EPA
1	4	June 1970	EPA
1	5	September 1972	EPA
1	6	September 1972	EPA
1	10	November 1972	NBI
1	17	July 1973	NBI
1	23	June 1973	MTU
1	29	August 1973	MTU
2	7	September 1973	EPA
2	11	November 1972	NBI
2	16	July 1973	NBI
2	22	June 1973	MTU
2	28	August 1973	MTU
3	1	June 1970	EPA
3	2	June 1970	EPA
3	8	September 1972	EPA
3	9	September 1972	EPA
3	21	June 1973	MTU
3	27	August 1973	MTU
4	12	November 1972	NBI
4	13	November 1972	NBI
4	14	July 1973	NBI
4	15	July 1973	NBI
4	18	June 1973	MTU
4	19	June 1973	MTU
4	20	June 1973	MTU
4	24	August 1973	MTU
4	25	August 1973	MTU
4	26	August 1973	MTU

EXHIBIT 7

Samples collected by EPA, NBI, and MTU in Big Bay Harbor.

Sample Number	Collecting Agency	Date Collected
1-4	EPA	June, 1970
5-9	EPA	September, 1972
10-13	NBI	November, 1972
14-17	NBI	July, 1973
18-23	MTU	June, 1973
24-29	MTU	August, 1973

EXHIBIT 7

Evaluation Parameters	SAMPLE 1	2	3	4	5	6	7
Volatile Solids (%)	.4	1.2	2.9	.4	67.0	12.0	23.2
Oil & Grease (mg/kg)	940	1600	1550	860	4900	3700	4000
C.O.D. (mg/kg)	1500	23000	48000	2700	108000	77400	213000
T. Nitrogen (mg/kg)	24	200	970	13	28400	2500	4600
T. Phosphorus (mg/kg)	90	200	440	150	47	26	12
pH							
Arsenic (mg/kg)							
Cadmium (mg/kg)							
Copper (mg/kg)							
Lead (mg/kg)	52.00	44.00	65.00	58.00	10.00	10.00	10.00
Mercury (mg/kg)	.90	.80	2.60	2.00	.10	.10	.10
Zinc (mg/kg)	7.00	17.00	10.00	0.00	1.00	16.00	26.00
Particle Size (%)							
30							
100							
230							
325							
PAN							

Results of laboratory analysis of bottom sediment samples collected in Big Bay Harbor by EPA, NBI, and MTU.

EXHIBIT 7

Evaluation Parameters	SAMPLE 8	9	10	11	12	13	14
Volatile Solids (%)		.5	5.2	.6	.9	.8	.5
Oil & Grease (mg/kg)		400	908	1030	836	1560	2730
C.O.D. (mg/kg)		1600	68700	1465	7714	1040	1950
T. Nitrogen (mg/kg)		0	1850	190	229	143	261
T. Phosphorus (mg/kg)		3	665	182	396	371	229
pH							6.9
Arsenic (mg/kg)							2.60
Cadmium (mg/kg)			0.00	0.00	0.00	0.00	6.60
Copper (mg/kg)			29.60	25.00	11.50	21.90	25.30
Lead (mg/kg)		10.00	32.40	12.90	8.80	14.70	3.60
Mercury (mg/kg)		.10					.30
Zinc (mg/kg)		23.00	43.90	49.40	21.60	46.20	29.60
Particle Size (%)							
30			1.2	98.8	.2	.3	.1
100			78.1	1.0	70.9	74.0	93.3
230			7.1	.2	27.4	24.6	6.0
325			3.5	0.0	1.4	1.0	.6
PAN			.1	0.0	.1	.1	0.0

Results of laboratory analysis of bottom sediment samples collected in Big Bay Harbor by EPA, NBI, and MTU continued.

EXHIBIT 7

Evaluation Parameters	15	16	17	18	19	20	21
	SAMPLE						
Volatile Solids (%)	.4	.5	5.0	.3	.5	.3	.4
Oil & Grease (mg/kg)	2080	2200	1745			382	
C.O.D. (mg/kg)	2280	3550	7	1550	1270	2220	815
T. Nitrogen (mg/kg)	229	227	1594	234	225	224	344
T. Phosphorus (mg/kg)	217	142	468	38	35	41	10
pH	7.0	6.5	6.9	7.2	7.7	7.4	6.8
Arsenic (mg/kg)	2.00	.10	2.90	.08	.25	.18	.09
Cadmium (mg/kg)	9.00	7.80	10.60	<.5	<.5	<.5	<.5
Copper (mg/kg)	9.40	40.40	12.70	43	48	49	11
Lead (mg/kg)	2.20	2.40	15.50	8.3	11.6	6.9	9.0
Mercury (mg/kg)	.20	.20	10.10	.63	<.10	<.10	<.26
Zinc (mg/kg)	41.40	48.90	47.80	12.2	14.1	12.3	7.6
Particle Size (%)							
30	.7	1.9	.4	.2	0	.3	1
100	94.6	96.4	56.1	97	85	94	97.3
230	4.0	1.3	29.2	2.6	13.9	5.1	1.7
325	.6	.3	12.8	.2	.3	0	0
PAN	.1	.1	1.5	0	.2	.6	0

Results of laboratory analysis of bottom sediment samples collected in Big Bay Harbor by EPA, NBI, and MTU continued.

EXHIBIT 7

Evaluation Parameters	SAMPLE 22	23	24	25	26	27	28
Volatile Solids (%)	.7	14.2	.3	.3	.3	.3	.4
Oil & Grease (mg/kg)			550		1390	680	
C.O.D. (mg/kg)	24300	133000	1950				960
T. Nitrogen (mg/kg)	560	300	246	378	363	250	273
T. Phosphorus (mg/kg)	40	33	33	55		32	32
pH	6.3	5.4	6.9	6.8	6.9	6.4	6.6
Arsenic (mg/kg)	.15	.28	.15	.20	.18	.17	.22
Cadmium (mg/kg)	<.5	<.5	1.5				
Copper (mg/kg)	11	12	15	10.6	10.2	8.3	10.1
Lead (mg/kg)	9	8.3	28.9	<8	<8	<8	<8
Mercury (mg/kg)	.26	.31	.32	<.10	<.10	<.10	<.10
Zinc (mg/kg)	7.2	27.2	7.6	6.1	6.8	6.6	11.7
Particle Size (%)							
30	3.6	11.7	.6	1	0	1.7	1
100	93.3	54.5	96.8	97	95.9	84.6	97.5
230	1.7	2.3	11.4	2.1	1.8	3.3	13.3
325	.5	8	.1	.1	0	.2	0
PAN	.3	14.3	.4	.1	.8	.2	.5

Table 3. Results of laboratory analysis of bottom sediment samples collected in Big Bay Harbor by EPA, NBI, and MTU. (continued)

EXHIBIT 7

Evaluation Parameters	SAMPLE 29
Volatile Solids (%)	9.3
Oil & Grease (mg/kg)	1800
C.O.D. (mg/kg)	55100
T. Nitrogen (mg/kg)	
T. Phosphorus (mg/kg)	56
pH	7.3
Arsenic (mg/kg)	.23
Cadmium (mg/kg)	
Copper (mg/kg)	12.0
Lead (mg/kg)	< 8.00
Mercury (mg/kg)	< 0.10
Zinc (mg/kg)	19.7
Particle Size (%)	
30	9.4
100	72.7
230	9.1
325	3.1
PAN	5.7

Results of laboratory analysis of bottom sediment samples collected in Big Bay Harbor by EPA, NBI and MTU (continued).

EXHIBIT 7

Evaluation Parameter	SAMPLE S 18	S 19	S 20	S 21	S 22	S 23	S 24
Dissolved O_2 (ppm)	11.9	11.6	11.6	11.6	11.1	11.6	7.9
Temperature (°C)	8.5	8.0	8.1	9.0	10.0	11.5	19.0
pH	7.8	7.8	7.8	7.8	7.7	7.6	7.5
Turbidity (JTU)	.2	.2	.3	.5	1.2	1.6	.6
Conductivity (μ Siemens) (25 C)	76	75	72	76	76	76	76
Alkalinity (ppm)	42	44	41	44	46	46	40
T. Nitrogen (ppm)	.700	.700	.600	.600	.700	.500	.800
T. Phosphorus (ppm)	.047	.087	.087	.096	.082	.120	.050
Mercury (ppm)	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Lead (ppm)	<.04	<.04	<.04	<.04	<.04	<.04	<.04
Zinc (ppm)	.022	.019	.026	.022	.032	.034	.021
Cadmium (ppm)	<.005	<.005	<.005	<.005	<.005	<.005	.007
Copper (ppm)	<.005	.006	<.005	.011	.011	.015	<.010
Arsenic (ppm)	<.007	<.007	<.007	-	<.007	<.007	<.007

Results of laboratory analysis of water samples collected in the Big Bay by MTU and NBI.
S = sample collected one meter below the water surface, B = sample collected one meter above the bottom.

EXHIBIT 7

Evaluation Parameter	SAMPLE S 25	S 26	S 27	S 28	S 29	B 10	B 11
Dissolved O_2 (ppm)	6.9	7.2	8.2	6.6	5.1	-	-
Temperature (°C)	19.5	18.5	19.5	19.7	20.5	4.0	4.0
pH	7.5	7.6	7.1	7.3	7.3	7.4	7.5
Turbidity (JTU)	.2	.2	1.6	2.0	2.0	14.0	6.0
Conductivity (μ Siemens) (25 C)	75	80	79	81	80	78	78
Alkalinity (ppm)	41	40	42	39	40	68	58
T. Nitrogen (ppm)	.910	.870	.683	.470	.680	.210	.220
T. Phosphorus (ppm)	.092	.058	.104	.120	.140	.840	.370
Mercury (ppm)	<.001	<.001	<.001	<.001	<.001		
Lead (ppm)	<.04	<.04	<.04	<.04	<.04		
Zinc (ppm)	.022	.021	.022	.045	0.22		
Cadmium (ppm)	<.005	<.005	<.005	<.005	<.005		
Copper (ppm)	.011	<.010	.010	.010	.010		
Arsenic (ppm)	<.007	<.007					

Results of laboratory analysis of water samples collected in the Big Bay by MTU and NBI.
S = sample collected one meter below the water surface, B = sample collected one meter above the bottom.

EXHIBIT 7

Evaluation Parameter	SAMPLE B 12	B 13	B 14	B 15	B 16	B 17	B 18
Dissolved O_2 (ppm)	-	-	10.1	10.0	9.8	9.6	11.6
Temperature (°C)	4.0	4.0	13.5	13.0	13.0	12.5	8.0
pH	7.6	7.7	8.2	8.1	7.9	8.0	7.8
Turbidity (JTU)	4.0	3.5	3.7	4.0	4.5	5.0	.2
Conductivity (μ Siemens) (25 C)	76	74	-	-	-	-	75
Alkalinity (ppm)	58	60	53	45	56	40	43
T. Nitrogen (ppm)	.170	.180	.621	.490	.741	.001	.600
T. Phosphorus (ppm)	.300	.270	.010	.021	.018	.011	.096
Mercury (ppm)							<.001
Lead (ppm)							<.04
Zinc (ppm)							.019
Cadmium (ppm)							<.005
Copper (ppm)							<.005
Arsenic (ppm)							<.007

Results of laboratory analysis of water samples collected in the Big Bay by MTU and NBI.
S = sample collected one meter below the water surface, B = sample collected one meter above the bottom.

EXHIBIT 7

Evaluation Parameter	SAMPLE B 19	B 20	B 21	B 22	B 23	B 24	B 25
Dissolved O_2 (ppm)	11.4	11.6	11.4	11.9	11.9.	8.8	9.5
Temperature (°C)	8.0	8.0	8.0	8.2	8.0	18.5	18.5
pH	7.7	7.8	7.9	7.7	7.6	7.5	7.6
Turbidity (JTU)	.2	.2	.3.	.3	.6	.2	.2
Conductivity (μ Siemens) (25 C)	74	74	76	74	92	79	76
Alkalinity (ppm)	42	42	42	44	42	40	38
T. Nitrogen (ppm)	.500	.500	.700	.700	.900	.917	1.100
T. Phosphorus (ppm)	.082	.120	.138	.120	.096	.098	.088
Mercury (ppm)	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Lead (ppm)	<.04	<.04	<.04	<.04	<.04	<.04	<.04
Zinc (ppm)	.020	.022	.030	.026	.028	.022	.013
Cadmium (ppm)	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Copper (ppm)	<.005	.006	.013	.011	.011	.010	<.010
Arsenic (ppm)	<.007	<.007	<.007	<.007	<.007	.008	<.007

Results of laboratory analysis of water samples collected in the Big Bay by MTU and NBI.
S = sample collected one meter below the water surface, B = sample collected one meter above the bottom.

EXHIBIT 7

Evaluation Parameter	SAMPLE B 26	B 27	2 28	B 29
Dissolved O_2 (ppm)	7.3	6.0	5.4	7.2
Temperature (°C)	18.5	18.7	18.3	18.8
pH	7.6	7.5	7.3	7.2
Turbidity (JTU)	.2	.6	1.6	1.5
Conductivity (μ Siemens) (25 C)	75	80	83	78
Alkalinity (ppm)	38	37	40	38
T. Nitrogen (ppm)	1.200	.683	.670	.510
T. Phosphorus (ppm)	.735	.216	.135	.120
Mercury (ppm)	<.001	<.001	-	<.001
Lead (ppm)	<.04	<.04	<.04	<.04
Zinc (ppm)	.018	.031	.020	.020
Cadmium (ppm)	<.005	<.005	<.005	<.005
Copper (ppm)	.011	.010	.010	.010
Arsenic (ppm)	<.007			

Results of laboratory analysis of water samples collected in the Big Bay by MTU and NBI. S = sample collected one meter below the water surface, B = sample collected one meter above the bottom.

EXHIBIT 7

Benthic Invertebrates Collected by MTU and NBI with a nine inch x nine inch Ponar Dredge at Big Bay.

Sample Number	Organism	Number Present
10	Procladius	3
10	Unidentified Chironomids	2
10	Peloscolex	3
10	Lumbriculus	4
10	Hyalella	1
10	Psychomyia	3
10	Helobdella	1
11	Procladius	1
11	Peloscolex	4
11	Lumbriculus	3
11	Palpomyia	1
11	Psychomyia	1
11	Pontoporeia	2
12	Eukiefferiella	3
12	Lumbriculus	3
13	Eukiefferiella	1
13	Cryptochironomus	1
13	Chironomus	1
13	Unidentified Chironomid	2
13	Pontoporeia	1
14	Cryptochironomus	1
14	Unidentified Chironomid	1
15	Cryptochironomus	2
16	Eukeifferiella	1
16	Lumbriculus	3
16	Limnodrilus	2
16	Peloscolex	5
16	Gyraulus	1
17	LOST	
18	Paralauterborniella	1
19	Diamesa	1
19	Paralauterborniella	2
20	Unidentified Chironomid	1

EXHIBIT 7

Big Bay Continued.

Sample Number	Organism	Number Present
21	Cryptochironomus	1
21	Limnodrilus	4
21	Lumbriculidae	1
21	Hyalella	1
22	Eukiefferiella	1
22	Pentaneurini	1
22	Peloscolex	3
22	Lumbriculidae	8
22	Psychomyia	1
22	Hirudinea	1
23	Procladius	1
23	Unidentified Orthocladiinae	1
23	Peloscolex	6
23	Lumbriculidae	3
23	Tubifex	6
23	Limnodrilus	1
24	Constempellina	7
24	Limnodrilus	1
25	Paralauterborniella	9
25	Chironomus	1
26	Eukiefferiella	1
26	Constempellina	14
27	Chironomus	1
27	Eukiefferiella	2
27	Unidentified Chironomid	3
27	Lumbriculus	1
28	Procladius	1
28	Cryptochironomus	1
28	Heterotrissocladius	3
28	Dicrotendipes	2
28	Peloscolex	26
28	Limnodrilus	1
28	Tubifex	2
28	Hyalella	2
29	Procladius	7
29	Chironomus	7
29	Peloscolex	6

Phytoplankton and zooplankton collected at Big Bay Harbor in the summer of 1973 by MTU. Those organisms listed below "* =" are considered to be zooplankton.

18

	#/1
Asterionella	550
Synedra	220

19

	#/1
Asterionella	500
Synedra	130
Unknown green filamentous, simple branching	250
Arthrospira	60
Tabellaria	60

20

	#/1
Asterionella	2150
Synedra	630
Frustulia	90
Dinobryon	90

21

	#/1
Asterionella	1950
Synedra	1030
Tabellaria	100
Arthrospira	200
Rhizoselenia	100
* =	
Daphnia	100

22

	#/1
Asterionella	1070
Synedra	620
Arthrospira	350
Merimopedia	90
Anabaena	90

23

	#/1
Asterionella	3000
Arthrospira	570
Synedra	280
Dinobryon	140
Tabellaria	140

EXHIBIT 7

Phytoplankton and zooplankton collected at Big Bay Harbor in the summer of 1973 by MTU. Those organisms listed below "* =" are considered to be zooplankton.

24

	#/l
Asterionella	1040
Dinobryon	390
Tabellaria	130
Cymbella	130
Synedra	260
Cosmarium	130

25

	#/l
Rhizosolenia	100
Amphora	100
Asterionella	100
Attheya	100
Synedra	100
* =	
Cyclops	100

26

	#/l
Tabellaria	140
Asterionella	70
Rhizosolenia	70

27

	#/l
Dinobryon	2620
Tabellaria	300
Asterionella	400
Synedra	100
Glaucocystis	200
Fragilaria	200
* =	
Cyclops nauplius larvae	100
Daphnia	

28

	#/l
Dinobryon	9360
Asterionella	440
Tabellaria	880
Fragilaria	150
* =	
Daphnia	300
unknown rotifer	440

29

	#/l
Dinobryon	4730
Asterionella	470
Synedra	60
Rhizosolenia	60
Tabellaria	120
Nitzchia	60
Cymatopleura	60
Mallamonas	60
* =	
Cladoceran	60
Daphnia brood cage	180

EXHIBIT 7

Bacteriological analysis of water samples from Big Bay, collected by MTU in the summer of 1973. Surface samples (S) and bottom samples (B) were collected one meter below the surface and one meter above the bottom.

Sample	Zone	Date	Total Coliforms	Fecal Coliforms
23S	1	6/73	23	9
23B	1	6/73	4	<3
29S	1	8/73	20	9
29B	1	8/73	4	<3
22S	2	6/73	43	9
22B	2	6/73	<3	<3
28S	2	8/73	9	4
28B	2	8/73	9	<3
21S	3	6/73	7	<3
21B	3	6/73	4	<3
27S	3	8/73	7	7
27B	3	8/73	4	4
18S	4	6/73	4	<3
18B	4	6/73	4	<3
24S	4	8/73	93	9
24B	4	8/73	4	<3
19S	4	6/73	<3	<3
19B	4	6/73	4	<3
25S	4	8/73	23	<3
25B	4	8/73	<3	<3
20S	4	6/73	<3	<3
20B	4	6/73	4	<3
26S	4	8/73	4	4
26B	4	8/73	4	4

EXHIBIT 7

Fish of Big Bay

Scientific Name	Common Name
Class Agnatha - jawless fishes	
Petremyzontidae - lampreys	
Petremyzon marinus	Sea lamprey
Class Osteichthyes - bony fishes	
Salmonidae - trouts	
Coregonus artedii	Cisco or Lake herring
Coregonus clupeaformis	Lake whitefish
Coregonus hoyi	Bloater
Oncorhynchus gorhuscha	Pink salmon (odd year cycle).
Oncorhynchus kisutch	Coho salmon
Oncorhynchus tshawytscha	Chinook salmon
Prosopium cylindraceum	Round whitefish
Salmo gairdreri	Rainbow trout
Salmo trutta	Brown trout
Salvelinus fontinalis	Brook trout
Salvelinus namaycush	Lake trout
Salmo salar	Atlantic salmon
Osmeridae - smelts	
Osmerus mordax	Rainbow smelt American smelt
Esocidae - pikes	
Esox lucius	Northern pike
Cyprinidae - minnows and carps	
Cyprinus carpie	Carp
Notropus athorinoides	Emerald shiner
Notropus hudsonius	Spottail shiner
Semotilus atromaculatus	Creek chub
Rhinichthys atratulus	Black nosed dace
Catostomidae - suckers	
Catostomus catostomus	Longnose sucker
Catostomus commersoni	White sucker
Maxostoma macrolepidotum	Northern redhorse
Gadidae - codfishes	
Lota lota	Burbot
Gasterosteidae - sticklebacks	
Pungitius pungitius	Ninespine stickleback
Gasterosteus aculeatus	Threespine sticlkeback
Centrarchidae - sunfishes	
Micropterus dolomieui	Smallmouth bass
Ambloplites rupestris	Rock bass
Leponis maroch	Bluegill

EXHIBIT 8

Fish of Big Bay (Continued)

Scientific Name	Common Name
Percidae - perches	
Etheostoma nigrum	Johnny darter
Perca flavescens	Yellow perch
Stizestedion vitreum vitreum	Walleye
Cottidae - sculpins	
Cottus bairdi	Mottled scuplin
Cottus cagnaxus	Slimy sculpin
Cottus ricei	Spoonhead sculpin
Acipenseridae	
Acipenser fulvescens	Lake sturgeon

* Names are in agreement with the American Fisheries Society, 1970.

NCSED-ER 7 January 1975

Ms. Martha M. Bigelow
Division of Michigan History
Department of Natural Resources
208 North Capitol Avenue
Mutual Building
Lansing, Michigan 48933

Dear Ms. Bigelow:

We are now in the process of preparing a draft environmental impact statement for operation and maintenance and the existing erosion problem at Big Bay Harbor, Marquette County, Michigan.

In general, the statement will discuss the environmental impacts of Corps of Engineers activities necessary to maintain and operate the harbor. These involve normal breakwater repair and maintenance dredging. The Corps removes an annual average of 3,000 to 4,000 cubic yards of dredge material. This dredging is necessary in order to keep the harbor open as a harbor-of-refuge.

The sediments dredged from within the natural shoreline of the harbor are classified polluted by the Environmental Protection Agency. It is estimated that approximately 2,000 cubic yards of these polluted sediments will be dredged from the inner harbor in the next ten years. Plans are to dispose of these dredged sediments on land in a 2[illegible]-acre area just south of the harbor, which is the site currently being used for such disposal. A map is inclosed which shows the location of the disposal site. Sediments dredged from outside the harbor's natural shoreline are classified nonpolluted and would be disposed of in the open lake or used as beach nourishment in the eroded area east of the east breakwater.

In compliance with Section 106 of the National Historic Preservation Act of 1966 and Executive Order 11593, we are requesting your comments concerning the existence of any historical, archeological, and paleontological resources which may exist in the vicinity of Big Bay Harbor, Marquette County, Michigan, and which may be affected by operation and maintenance activities in the harbor.

NCSED-ER 7 January 1975

Ms. Martha M. Bigelow

The draft environmental impact statement is scheduled for completion in [illegible], and a copy will be furnished you at that time.

If we can be of any further assistance, please contact us.

Sincerely yours,

MAX W. NOAH
Colonel, Corps of Engineers
District Engineer

3 Incl
1. Map of Lake Superior projects, showing loc. of Big Bay Harbor
2. Map of Big Bay Harbor, showing proposed disposal site
3. List of those receiving identical letter

EXHIBIT 9

List of those receiving identical letters:

Ms. Martha M. Bigelow
Division of Michigan History
Department of Natural Resources
208 North Capitol Avenue
Mutual Building
Lansing, Michigan 48933

Mr. James Fitting
State Archeologist
Department of Natural Resources
Stevens T. Mason Building
Lansing, Michigan 48926

Mr. Wilfred M. Husted
Archeologic Salvage Coordinator
U.S. Department of the Interior
National Park Service
143 South 3rd Street
Philadelphia, Pennsylvania 19106

Incl 3

MICHIGAN DEPARTMENT OF STATE
RICHARD H. AUSTIN SECRETARY OF STATE

LANSING
MICHIGAN 48918
(517) 373-0510

MICHIGAN HISTORY DIVISI
ADMINISTRATION, PUBLICATION
RESEARCH, AND HISTORIC SITE
208 N. Capitol Avenue
STATE ARCHIVES
3405 N. Logan Street
STATE MUSEUM
505 N. Washington Avenue

January 15, 1975

Colonel Max W. Noah
U.S. Army Corps of Engineers
1210 U.S. Post Office and Customs House
St. Paul, Minnesota 55101

Dear Colonel Noah:

In response to your inquiry about archaeological resources in the Big Bay Harbor area in Marquette County, Michigan, I can state that we have no record of specific sites in our files. However, we do have a local history manuscript which indicates that a 17th century burial was found in the vicinity of Squaw Beach. Independence Lake had an indian place name (Soosoowagami) and it is very likely, on topographical grounds, that there were indian encampments in the Big Bay vicinity.

Your project involves a minimal amount of dredging and disposal but there is a possibility that all, or part, of a site might be covered. While such dumping might obliterate, but not destroy, such a site, it would be advisable to sponsor a one day test pitting project to check the disposal area now and clear it for possible future development.

Sincerely,

James E. Fitting
State Archaeologist
Michigan History Division

JEF/cw
cc: Mike Washo
M. Bigelow
K. Eckert
M. Buckmaster

EXHIBIT 9

United States Department of the Interior

NATIONAL PARK SERVICE
MIDWEST REGION
1709 JACKSON STREET
OMAHA, NEBRASKA 68102

IN REPLY REFER TO:

L7423 MWR CL

JAN 31 1975

Colonel Max W. Noah
District Engineer
St. Paul District, Corps of Engineers
1210 U. S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Colonel Noah:

Reference your letter of January 7, 1975, pertaining to operation and maintenance and the existing erosion problem at Big Bay Harbor, Marquette County, Michigan.

No established or studied units of the National Park Service or sites registered or eligible for registration as National Historic, Natural or Environmental Educational Landmarks appear to be adversely affected by the proposal. Accordingly, we have no objections to the performance of this work as related to this area.

The draft statement should present evidence of consultation with the Michigan State Historic Preservation Officer, Dr. Martha Bigelow, Director, Michigan History Division, Department of State, Lansing, Michigan 48918, and the State Archeologist, Dr. James E. Fitting, Michigan History Division, Department of State, Lansing, Michigan 48918. The opinion of the State Historic Preservation Officer should be sought regarding potential effect of the project on any sites listed in or eligible for inclusion in the National Register of Historic Places. The National Register of Historic Places (including monthly supplements published in the Federal Register) should be consulted, however, because a site may be in the process of evaluation or nomination, the opinion of the SHPO should be presented in the statement. The State Archeologist should be consulted regarding the need for an archeological survey of the project area and his recommendations presented.

Sincerely yours,

Merrill D. Beal

Merrill D. Beal
Acting Regional Director

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

EXHIBIT 9

MICHIGAN DEPARTMENT OF STATE
RICHARD H. AUSTIN SECRETARY OF STATE

LANSING
MICHIGAN 48918
(517) 373-0510
MICHIGAN HISTORY DIVISION
ADMINISTRATION, PUBLICATIONS, RESEARCH, AND HISTORIC SITES
208 N. Capitol Avenue
STATE ARCHIVES
3405 N. Logan Street
STATE MUSEUM
505 N. Washington Avenue

January 16, 1975

Colonel Max W. Noah
U.S. Army Corps of Engineers
1210 U. S. Post Office and Customs House
St. Paul, Minnesota 55101

Dear Colonel Noah:

Your letter requesting comments on historical resources in the vicinity of Big Bay Harbor, Marquette County, Michigan, has been referred to me by Dr. Martha Bigelow, Director, Michigan History Division.

The Michigan History Division has not yet conducted a systematic survey of cultural resources in Marquette County. However, the USGS-Big Bay Quadrangle, 1:62500, 1954, indicates a ruins, probably dock pilings, along the Lake Superior shoreline, 1/4 mile north of Burns Landing.

I suggest you contact the Marquette Historical Society and the Architectural Heritage Committee to determine the historic sites identified locally: Esther B. Bystrom, Executive Secretary, Marquette Historical Society, Longyear Research Library, 213 North Front Street, Marquette 49855 (1-906-226-6821); Paul Bilgen, Architectural Heritage Committee, P.O. Box 336, Marquette 49855 (1-906-226-3640).

Very truly yours,

Kathryn B. Eckert

Kathryn B. Eckert
Historic Preservation Coordinator
Michigan History Division

cc: M. Washo
M. Bigelow

EXHIBIT 9

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
1210 U. S. POST OFFICE & CUSTOM HOUSE
ST. PAUL, MINNESOTA 55101

IN REPLY REFER TO
NCSED-ER

7 February 1975

Ms. Esther B. Bystrom
Executive Secretary
Marquette Historical Society
Longyear Research Library
213 North Front Street
Marquette, Michigan 49855

Dear Ms. Bystrom:

We are now in the process of preparing an environmental assessment report for operation and maintenance and the erosion problem at Big Bay Harbor, Marquette County, Michigan.

In general, the report will discuss the environmental impacts of Corps of Engineers activities necessary to maintain and operate the harbor. These involve normal breakwater repair and maintenance dredging. The Corps removes an annual average of 3,000 to 4,000 cubic yards of dredge material. This dredging is necessary in order to keep the harbor open as a harbor-of-refuge.

The sediments dredged from within the natural shoreline of the harbor are classified polluted by the Environmental Protection Agency. It is estimated that approximately 2,000 cubic yards of these polluted sediments will be dredged from the inner harbor in the next 10 years. Plans are to dispose of these dredged sediments on land in a 2 1/2-acre area just south of the harbor, which is the site currently being used for such disposal. A map is inclosed which indicates the location of the disposal site and designates the inner (polluted) and outer (unpolluted) portions of the harbor. Sediments dredged from outside the harbor's natural shoreline are classified nonpolluted and would be disposed of in the open lake or used as beach nourishment in the eroded area east of the east breakwater.

As suggested in the inclosed letter from Ms. Kathryn B. Eckert of the Michigan History Division, we are requesting your comments concerning the existence of any historical, archaeological and paleontological resources which may exist in the vicinity of Big Bay Harbor, Marquette County, Michigan, and which may be affected by the operation and maintenance activities in the harbor. In particular, we would appreciate receiving any information you may have concerning the ruins, mentioned in

EXHIBIT 9

NCSED-ER 7 February 1975
Ms. Esther B. Bystrom

Ms. Eckert's letter, which are under water approximately one-fourth mile north of the harbor (see inclosure 2).

Thank you for your help in this matter.

Sincerely yours,

MAX W. NOAH
Colonel, Corps of Engineers
District Engineer

Incls
1. Map of Lake Superior projects showing location of Big Bay Harbor
2. Map of Big Bay Harbor showing proposed disposal site and site of submerged ruins
3. Letter from Ms.Kathryn B. Eckert

Identical letter to:
Mr. Paul Bilgin
Architectural Heritage Committee

EXHIBIT 9

THE ARCHITECTURAL HERITAGE
COMMITTEE OF MARQUETTE
P.O. BOX 336
MARQUETTE, MICHIGAN 49855

Colonel Max W. Noah
Corps of Engineers, St. Paul District
Department of the Army
1210 U.S. Post Office
St. Paul, Minnesota 55101

Dear Colonel Noah:

Thank you for your letter of December 7, 1975.

The Architectural Heritage Committee of the City of Marquette has no hard information regarding historical, archaeological or paleontological resources in the Big Bay Harbor area.

In particular, we are well enough acquainted with the "submerged ruins" shown on the chart entitled "Big Bay Harbor, Michigan", which you included, to acknowledge their existence, but not to comment on their potential significance.

Perhaps in the near future, with the help of the Michigan History Division, Department of State, a recomendation can be made as to the potential significance of this area to aid you in future planning. We will be glad to do anything we can to help in this regard.

Sincerely,

Paul R. Bilgen

Paul R. Bilgen
Chairman
ARCHITECTURAL HERITAGE COMMITTEE
MARQUETTE, MICHIGAN

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

IN REPLY REFER TO:
ES-FWP

JAN 30 1975

Colonel Max W. Noah
District Engineer
U. S. Army Engineer District
St. Paul
1210 U. S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Noah:

Please refer to your letter of December 24, 1974 (NCSED-F), concerning the proposed spoil disposal site for Big Bay Harbor, Marquette County, Michigan, as described in the "Brief Letter Report on Confined Dredge Disposal for Big Bay Harbor, Michigan." We have reviewed the Brief Letter Report and concur with your selected upland spoil area.

We are particularly pleased that an upland site has been chosen to confine the polluted spoil and also that possible municipal use of the spoil is being investigated.

Our letter to you of November 25, 1974, offered our views regarding shoreline damage prevention and mitigation at Big Bay Harbor and three other Lake Superior Harbors. We indicated that in-water work should not be performed between October 15 and ice-up, so the project-related turbidity would not disrupt lake trout reproduction. Our most recent conversation with the Michigan Department of Natural Resources (MDNR) indicated that since lake trout do not spawn in the harbor, the time frame indicated in our previous letter need not apply to in-water work done completely within Big Bay Harbor itself. We also were informed by MDNR that there are public beaches near Big Bay Harbor that could use more sand--Squaw Beach, for example. If unpolluted bottom material is found in significant quantity, we invite you to coordinate with us and MDNR before proceeding with the usual open lake disposal.

Sincerely yours,

Acting Regional Director

CONSERVE AMERICA'S ENERGY

CC: Director, Michigan Department of Natural Resources

Save Energy and You Serve America!

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING, LANSING, MICHIGAN 48926
HOWARD A. TANNER, Director

April 16, 1975

Colonel Max W. Noah
District Engineer
U. S. Army Corps of Engineers
1210 Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Noah:

Re: NCSED-F

Thank you for bringing to our attention the need for a response to your letter of December 24, 1974 regarding Big Bay Harbor in Marquette County.

We have reviewed the brief Letter Report on Confined Dredge Disposal for Big Bay Harbor, and concur with the selected upland spoil area for polluted material.

We are pleased to have the unpolluted dredge material used for public purposes. The attached letter dated August 31, 1973 to your Lake Superior Office in Duluth indicates our position in regards to use of the unpolluted spoil for beach nourishment.

Very truly yours,

Howard A. Tanner

Howard A. Tanner
Director

R1026 1/75

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING, LANSING, MICHIGAN 48925

A. GENE GAZLAY, Director

August 31, 1973

Courtland Mueller
St. Paul District Corps of Engineers
Lake Superior Area, Canal Park
Duluth, Minnesota 55802

Dear Mr. Mueller:

We understand that the Corps expects to have a maximum of 11,000 cubic yards of unpolluted dredged spoils from the Big Bay Harbor dredging which can be used for beach nourishment. The State of Michigan will offer no objection to the use of clean unpolluted material for a beach nourishment program on the east side of the Big Bay Harbor structures. No state permits will be required provided the sand is placed on the sandy portion of the bay.

Very truly yours,

BUREAU OF WATER MANAGEMENT
Hydrological Survey Division

Lawrence N. Witte, P.E.
Assistant Chief

RW/bw
cc: Herb Miller, Office of Planning Services
Col. R. Cox, U.S. Army Engineer District, St. Paul

EXHIBIT 10

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

MAY 1 1975

Colonel Max W. Noah
District Engineer
Department of the Army
St. Paul District, Corps of Engineers
1210 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Noah:

Reference is made to your letters of December 24, 1974 and April 7, 1975 (NCSED-F) concerning the maintenance of Big Bay Harbor, Michigan.

In the matter of site selection for containment of polluted dredge spoil, we attempt to consider each project on a site specific basis. Our objective is to maximize social benefits that may be derived from the proper disposal of materials while minimizing any adverse environmental impacts.

We have carefully reviewed all the information you sent us concerning the situation at Big Bay Harbor as well as the data and information obtained from our on-site inspection and sampling surveys. The bottom sediments in the inner portions of the harbor are slightly polluted, but considering that there is only 2000 cubic yards of polluted sediment that must be dredged over the next ten years, we feel that open lake disposal of this material would have no significant adverse environmental impacts on Lake Superior. You stated in your brief letter report, however, that the Marquette County Board of Road Commissioners has expressed an interest in using this dredged material for construction purposes if it was made available at an on land disposal site. Since this would be in line with our previously stated objectives, we strongly suggest you continue with your plans to place the inner harbor dredgings on the open area adjacent to the harbor (proposed disposal site) thereby optimizing the net benefits to society.

We appreciate the opportunity to comment on this project. If we can be of further assistance, please feel free to contact us.

Sincerely yours,

Christopher M. Timm

Christopher M. Timm, Acting Director
Surveillance and Analysis Division

EXHIBIT 10

FILME

-8